THE AEROPLANE

Incorporating
Aeronautical Engineering
Edited by -.- THURSTAN JAMES

Founder and First Editor
(1911-1939), C. G. GREY

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Chairman and
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Head Office:
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Telephone: Terminus 3636
Telegrams:
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Telex: 23839

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COMET CAPABILITIES

AHEAD of expectation, the D.H. Comet 4 flew on Sunday last. Meantime the struggle by TEAL to buy the aircraft of its choice to replace its obsolescent DC-6 aircraft is still being kept up. The ding-dong battle was still undecided as we went to press.

Not always is there unanimous support in this country for the principle that an airline should be permitted by the Government which controls it to buy such aircraft as its technical advisers may recommend. On this occasion, however, there is little doubt that this principle will be supported as warmly in this country as in New Zealand. In Australia the principle is certainly not accepted. There Senator Shane Paltridge, minister of civil aviation in that country, has recently vetoed the proposal by Ansett Airways, Australia's biggest independent operator, to buy three Electras (allegedly on technical grounds) and that by Trans-Australia Airlines, the Government-sponsored line, to buy two Caravelles. On this basis it is not illogical for the Australian Government, which owns a half-share in TEAL, to disagree with the 4-2 vote of the TEAL board to buy Comet 4 jetliners. Instead, TEAL is under pressure to buy Electras, just the aircraft Senator Paltridge will not let Ansett buy.

What are the circumstances of this involved struggle? TEAL, jointly owned in equal shares by the Governments of Australia and New Zealand, operates the trunk route which links New Zealand with Melbourne and Sydney and Fiji. Services over these routes are at present operated with three DC-6s. By buying Comet 4 jetliners TEAL would cut the 5-hr. journey across the Tasman Sea to 3 hours; obviously good for traffic. Moreover, four crossings a day could be made. Not only is such frequency good for utilization but the fortunate aircrew would be home each night. A further advantage, and full of possibilities, would be the fact that if TEAL bought Comets, a high-prestige jetliner service by Comet would run by way of New Zealand between London and Fiji.

Where can the snag be in such circumstances? It seems that Qantas have decided to buy three Lockheed Electras for their secondary services. It would be of advantage to Qantas to have standardization with the new TEAL equipment. But in fact there would be standardization if TEAL bought the Comet 4. Provision is being made at Sydney to service the Comets of B.O.A.C. The Comets for TEAL could equally well be serviced there. The Royal New Zealand Air Force has certain Canberras on order which are to have the same Rolls-Royce Avons as does the Comet 4, or as near as no matter the same. Thus servicing arrangements will be available for the engines of the Comet 4.

Meantime, as everybody is aware in this country, New Zealand is most concerned to maintain, and if possible improve, the market for her dairy produce in this country. Improved communication by Comet in such circumstances would be beneficial not only on the grounds of improved communications but on the basis of a sterling purchase. If Electras are forced on the New Zealanders they will have to find some dollars to pay for them.

People in this country, and no doubt in New Zealand, will be hard put to understand why an aeroplane which seems to have so much to commend it, should not receive the sanction of the Australian Government. Make no mistake about it, that government is strongly placed, for if the Australians were to withdraw their support from TEAL and make the decision to operate across the Tasman Sea on their own, present traffic figures are such that the weaker line would go to the wall.

But this is a threat, not an economic argument, and it is on arguments of economics that the board of TEAL have been persuaded. The Comet is a developed jetliner with a developed engine. No other jetliner in the World has so much operating experience in airline conditions behind it. Moreover, studies of traffics indicate strongly that the Comet is likely to be of the right size and to be able to operate at the optimum frequencies on the Tasman and Fiji routes for the next seven or eight or even nine years. It has a performance which enables it to meet competition effectively. And when expansion of routes becomes necessary, the Comet 4 is in a specially advantageous position as regards its requirements for runways, as concerns both length and loadings.

When all these things are considered, it certainly seems that every effort possible should be made to enable TEAL to get the aircraft of its choice. We wonder how many flights to the Antipodes and back have been made by the Comet 2 transports of R.A.F. Transport Command. Those aeroplanes have certainly been knocking back the hours. The latest figures we have been able to get were 10,000, published a month ago. These R.A.F. weekly services to Christmas Island by way of the North Atlantic set the scene for the forthcoming Keflavik-Gander Comet 2 flights by B.O.A.C. which begin next Monday. The Comet 4 will certainly have experience behind it.

B

MATTERS OF MOMENT

Plea for a Plan

IN the second of two articles which he has written for *The Sunday Times* under the heading "A Plan for Air Prosperity," Mr. Eric Turner has put forward a seven-point programme. As he is chairman and managing director of Blackburn and General Aircraft, Ltd., his views will not only be studied carefully but will carry much weight.

We are particularly glad to see that a point so often made in our pages comes next to first place on Mr. Turner's list; this is the fundamental need for a sustained and continuous research policy. This country will never be able to build supersonic air liners unless the necessary research is undertaken on a national basis. And this cannot be said too often.

Mr. Turner's fifth point is that the present international fare structure must be amended to allow national economics to govern aircraft procurement instead of decisions being taken which favour one class of vehicle. In this context it is worth recalling the article which Mr. John Brancker wrote for THE AEROPLANE (March 21 last). He was expressing his personal views, but as traffic director of IATA those views must be based on a wide experience. He outlined a formula for a basically low-cost, short-medium-haul transport. Such a specialized vehicle has yet to receive the attention of the manufacturing industry.

A Bad Year for B.O.A.C.

AFTER four successive years of profit, the provisional 1957-58 results for B.O.A.C. show an estimated net loss of £2,750,000, including an operating deficit of £750,000.

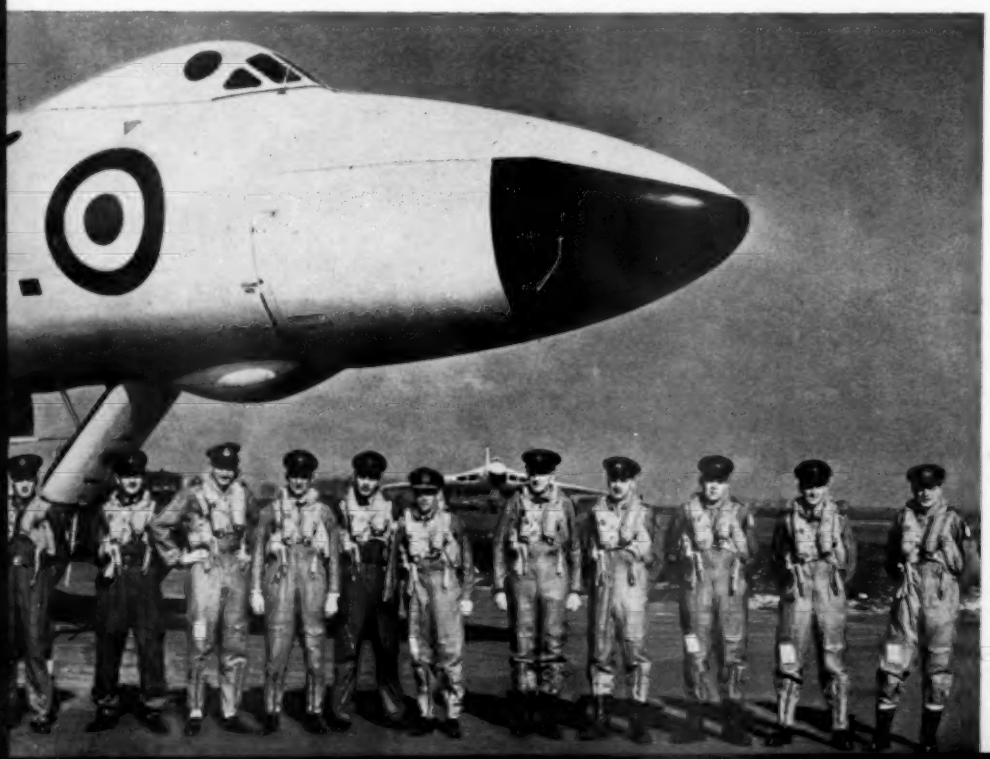
These facts were stated by Mr. Harold Watkinson, Minister of Transport and Civil Aviation, in a written Parliamentary answer on April 23. At the same time B.O.A.C. issued the following statement from Sir Gerard d'Erlanger:—

"The reason for the deficit will be dealt with in our Annual Report and Accounts; nevertheless, I did forecast at the time of publication of the previous year's results that the year 1957-58 would be a difficult one. In the event, it proved to be so and the results have been aggravated by delays in bringing new aircraft into service through late delivery, and by the recession in traffic growth brought about by the shortfall in revenues from countries suffering from the fall in commodity prices, as well as by a temporary winter decline in Atlantic travel due no doubt to the recession in America.

WISLEY VISITOR.—His Royal Highness The Duke of Edinburgh visited Vickers-Armstrongs (Aircraft) Ltd. on April 25. Here, he is at Wisley with Sir George Edwards. Behind are Cdr. D. Russell, R.N., C.O. of 700X Flight and Lieut. Cdr. P. B. Sindery, R.N., Scimitar project officer. Mr. H. H. Gardner, the company's chief engineer, military aircraft, and Cdr. M. J. Lithgow, the deputy chief test pilot, are on the left.

"For the current financial year, with the advent of further up-to-date aircraft and the elimination of obsolete types, together with other remedial factors, we look forward to considerably improved results. I am also glad to report that forward bookings are most encouraging."

The last period for which a net loss was returned by B.O.A.C. was 1952-53 (£838,664). This poor financial year was followed by the best so far in the history of the Corporation, when a



B-A BOUND.—With Air Vice-Marshal G. A. Walker (centre), the A.O.C. No. 1 Group, Bomber Command, and Force Commander of the R.A.F. mission attending the inauguration of the President of Argentina, are the crews of the two Avro Vulcans of No. 83 Squadron before their departure from Waddington to Buenos Aires on April 25.

Photograph copyright "The Aeroplane"

CONTENTS

MATTERS OF MOMENT 606
NEWS ITEMS 609
FOUR HOURS TO WARSAW ..611
AIR TRANSPORT 612
THE FIGHTING SERVICES ..616
RADAR RESEARCH AT MALVERN..617
HUNTER HISTORY 619
DEVELOPMENT TESTING OF THE ENGLISH ELECTRIC P.1 622
TARGET FOR TOMORROW ..626
FLYING THE AGRICULTURAL SUPER CUB, by John Fricker..631
PRIVATE FLYING AND GLIDING..633
CORRESPONDENCE 635
NOTES AND EVENTS 636

AIRBORNE HERALD.—This first air-to-air photograph of the Handley Page Dart Herald shows to advantage the attractive lines of this new short/medium-stage turbo-prop transport. It was described in detail with a cutaway drawing in THE AEROPLANE for March 21.

net profit of £1,065,397 was returned. There had been a small profit in 1951-52 following successive years in each of which there had been massive deficits of up to £8 million.

More P.1s for the R.A.F.

REPLYING to questions in the House of Commons on April 28, Mr. Aubrey Jones, Minister of Supply, said that further orders for the English Electric P.1 fighter and an order for a trainer version of it had been authorized. He did not reveal the number of aircraft involved, but Press reports have suggested that these orders cover at least 100 P.1s, and are worth more than £30 million.

These orders follow speculation about the future of R.A.F. Fighter Command in an age of surface-to-air missiles. On April 16, however, the Air Minister, the Hon. George Ward, said that no change was contemplated in the status of Fighter Command, which would continue to perform the rôle defined in the Defence White Paper. This was the defence of our bomber bases.

The first production order for the P.1 covered a development batch of 20 P.1B aircraft; these were ordered in February, 1954. In August, 1954, the first prototype flew and the second prototype followed suit 11 months later. Production jigs and tools were ordered in November, 1956, and news of an initial production order was given in December, 1956. Reports suggest that this order was for 50 aircraft.

Extensive development has been necessary for the supersonic P.1, which has a performance far ahead of that of current British fighters. An account of the work involved in the development of its airframe structure and system appears on pages 622 to 625 in this issue. Test flights with representative fighter aircraft have been carried out since April, 1957, when the P.1B prototype made its first flight.

Development of the aircraft as a mixed-powerplant fighter was announced in February this year, when it was stated that the P.1 could carry a Napier Double-Scorpion rocket motor in a ventral pack. Rocket power would increase the aircraft's rate of climb and improve its manœuvrability at altitude.

The F.A.I. Becomes Space Conscious

UNITED KINGDOM delegates at the 51st general conference of the Fédération Aéronautique Internationale held in Los Angeles from April 14 to 18 were the R.Ae.C. chairman, Mr. S. Kenneth Davies, Capt. K. J. G. Bartlett, and the secretary-general, Col. R. L. Preston. Some of the delegates flew from Frankfurt in a U.S.A.F. aircraft which had been put at the disposal of the F.A.I

The National Aeronautic Association sponsored and organized the conference, which was held in the Institute of Aeronautical Sciences, and which had as its central theme, the "Humanities of Aviation" as applied to the atomic age and the eventual space age. More than 270 people were present.

The preliminary programme before the official opening of the conference included a visit to the White House in Washington, where delegates were addressed by President Eisenhower, and later by Mr. John Foster Dulles. Flying to Fort Worth they inspected the Convair plant and other aircraft industries in Texas.

It was specially gratifying to the U.K. delegates to the conference that Capt. Bartlett was elected honorary president and a vice-president. He was president in 1952-54. Maj. Jacques Allez (France) was elected first vice-president.

Record Rules

ONE outcome of the 51st annual conference of the F.A.I. is that a new record must be confirmed by a national aero club within two months, and submitted to the F.A.I. within a further eight days, if it is to become officially accepted.

Since Maj. Adrian Drew, U.S.A.F., achieved a speed of 1,207.6 m.p.h. in a McDonnell F-101A Voodoo on December 12, 1957, it has not been officially confirmed as a World's air speed record, replacing that established by Peter Twiss with the Fairey F.D.2 (1,132 m.p.h.) on March 10, 1956, and the F.A.I. has given the American authorities until June 1 to submit details.

A Record for France

ON the evening of Friday, April 25, a Breguet Taon powered by a Bristol Orpheus 3 turbojet established a new 1,000-km. closed-circuit record at 649.7 m.p.h.; this record is, of course, subject to confirmation by the F.A.I. The aircraft was flown by M. Bernard Witt, the Breguet company's chief test pilot. The previous 1,000-km. closed-circuit record was held by Russia with a Tupolev Tu-104A, powered by two Mikhulin RD-3 turbojets, at 602 m.p.h. on September 24, 1957.

To have achieved the average speed of nearly 650 m.p.h. the Taon must have flown at near sonic speed for a considerable part of the time. The Orpheus engine installed in the aircraft was a standard 801 version which develops 4,850 lb. s.t. at its normal maximum r.p.m. We understand from Bristol that it was not in any way "hotted up" for the record attempt.

It seems, however, that since the Taon prototype made its first flight there has been some modification to the airframe in the way of further Area-ruling.

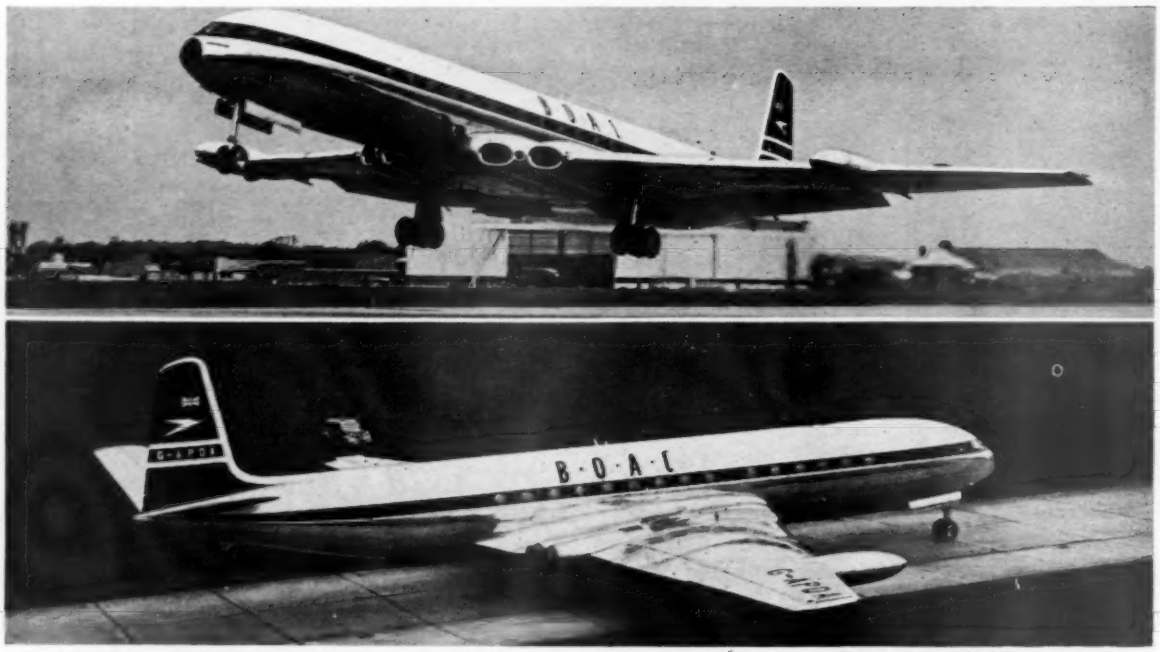
A Rolls-Royce Retirement

THE retirement of Mr. Willoughby Lappin, who has been with Rolls-Royce for more than 40 years, is announced.

All that time his object was not only to ensure a market for Rolls-Royce engines, but to see that they met requirements and were put to the best possible use. Probably he was the first to bring about an adequate co-ordination between the Services, aircraft designers and an engine company, and the long and reliable service which Rolls-Royce-powered aeroplanes have given to the R.A.F. is significant testimony to the efficiency of his methods.

It was because of his close co-operation with the users of Rolls-Royce products that he gained the respect of the Air Council and of the squadrons, and because of this also he could speak with authority when the design and specifications of new aircraft were discussed. Frequently he flew with Service and test pilots for experience of engine behaviour, and he became a member of the Auxiliary Air Force to advise and instruct on the operation of the Kestrel engines with which its aircraft were extensively equipped.

Willoughby Lappin was born on April 4, 1888. He served



Photograph copyright "The Aeroplane"

COMET ALOFT.—First flight of the de Havilland Comet 4 was on April 27. The aircraft was piloted by John Cunningham, and the flight lasted for 1 hr. 23 min. On its second flight, next day, the Comet 4 reached a height of 40,000 ft.

in the R.N.A.S. from 1914 to 1917, having been refused permission to accompany the first two R.F.C. squadrons to France, and for long was associated with the Rolls-Royce armoured cars of the naval service. With them he served in the German colonies in East Africa and in Egypt. On his return to England he tried, unsuccessfully, to be allowed to learn to fly; soon after it became possible for him to join Rolls-Royce. He entered the firm's London office and began his methods of co-ordination when the Eagle VIII-powered Handley Page V.1500s were being prepared, abortively, to bomb Berlin.

Right through the development of the famous Kestrel and Merlin engines he continued his work, and on his recommendation the latter engine was installed in the American Mustang fighter, which put it among the fastest piston-engined aircraft. He saw the entry into service of the first jet aircraft to be powered by Rolls-Royce engines—the Meteor—and his final experience with the company concerned the introduction of the Conway by-pass engine for both military and civil use.

As personal assistant to Lord Hives, chairman and managing director of Rolls-Royce until the end of 1956, he was able to use his own shrewd judgment to the full. It has been said of him, "This closeness to the chief, who was also a practical man, set the seal on his success. Lappin had ploughed his furrow straight and it matched the course set for the whole firm by its head."

A Bristol-Siddeley Combination

CONSOLIDATION in the British aero-engine industry was in the news earlier this week when it was announced that the Bristol Aeroplane Company, Ltd., and the Hawker Siddeley Group, Ltd., had jointly formed a new company to be known as Bristol-Siddeley Engines, Ltd. This will co-ordinate the activities of the two individual engine companies within the Groups concerned — Bristol Aero-Engines and Armstrong Siddeley Motors.

This combination of resources will make one of the largest and most important aeronautical powerplant concerns in the World. It will certainly provide a range of powerplants that compares favourably with that of any other group. As our readers are well aware, the products of the two component companies of the new organization are entirely complementary to each other and there is no duplication among their various turbojet, turboprop, ramjet and rocket engines.

Principally the strength of the new arrangement lies in the combined technical and production resources, research facilities and know-how that will lie at the disposal of the Bristol-Siddeley Engines company. Its capital assets will amount to more than £31 million and its labour force about 27,500.

In the joint statement that was made announcing the new company, it was explained that there would be a complete exchange of technical information between the two operating units—Armstrong Siddeley and Bristol Aero-Engines. Arrangements are also being made for combined production planning and inter-company sub-contracting.

The new company, it was said, will undertake the development of new projects supported by the Ministry of Supply (although it was made clear that this did not rule out the possibility of private venture projects if required). It will also submit proposals and accept contracts; and in fulfilling these will utilize the research, engineering and manufacturing resources of the two operating companies.

Chairman of Bristol-Siddeley Engines, Ltd., is Sir Arnold Hall, F.R.S., M.A., Hon.A.C.G.I., F.R.Ae.S., a director of the Hawker Siddeley Group; and the vice-chairman will be Air Cdre. F. R. Banks, C.B., O.B.E., Hon.F.A.I.S., F.R.Ae.S., M.I.Mech.E., F.Inst.Pet., a director of the Bristol Aeroplane Company. The remainder of the board of the new company will comprise members of the boards of its two components and will include: Air Chief Marshal Sir Alec Coryton, K.C.B., K.B.E., M.V.O., D.F.C.; Dr. S. G. Hooker, O.B.E., D.Phil., A.R.C.Sc., B.Sc., D.I.C., M.I.Mech.E., F.R.Ae.S.; Mr. G. L. Hack, M.I.Mech.E.; Mr. H. T. Chapman, C.B.E., M.I.Mech.E., F.R.Ae.S.; Mr. W. F. Saxton, M.B.E.; and Mr. W. H. Lindsey, M.A., F.R.Ae.S., M.I.Mech.E.

Ballistics at Hatfield

IT has now been officially announced that de Havilland Propellers, Ltd., are the prime contractors and co-ordinating authority for the design, development and firing trials of the British Intermediate Range Ballistic Missile. Associated with them in this project are the de Havilland Aircraft company, Rolls-Royce and the Sperry company.

Point to this statement has been given by the first public appearance of a test section of the missile's cylindrical carcase. This is about 60 ft. long and has a diameter of about 10 ft. and has now been moved into position in the large test rig which has been dominant at Hatfield for some months.

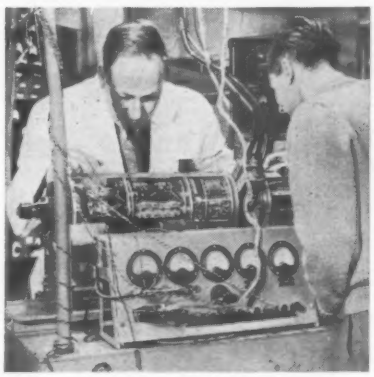
News of Aircraft, Engines and Missiles

HUNTING SALES.—A Hunting Jet Provost (Armstrong Siddeley Viper turbojet) was due to start a 7,000-mile tour of eight South American countries at the end of April. Venezuela, Colombia, Ecuador, Peru, Chile, Argentina, Uruguay and Brazil will be visited, and demonstrations will be given at more than a dozen places. The tour is to end in July. The aircraft was shipped to Trinidad.

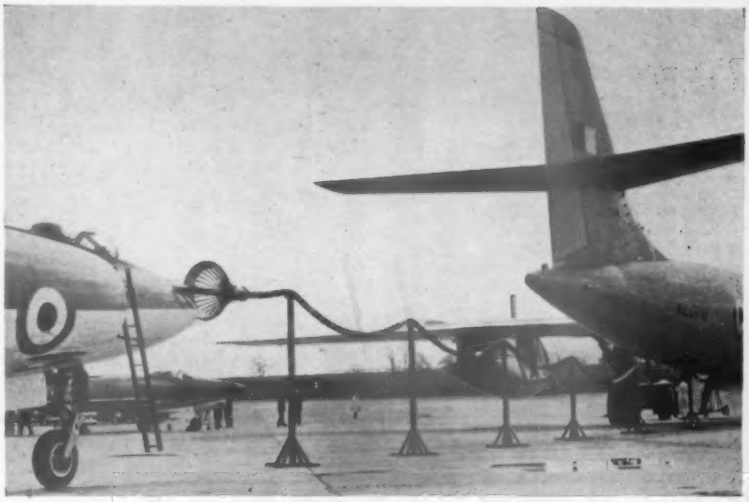
CUBAN WHIRLWINDS.—Two Westland Whirlwind helicopters have been shipped to Havana for service with the Cuban Air Force. Mr. John Fay, Westland's C.F.I., is to test them there and instruct Cuban pilots in handling them.

ARROW SPEED. — It has been reported by the R.C.A.F. that the Avro Aircraft Arrow has achieved 1,000 m.p.h. while in level flight at 50,000 ft.

VICKERS-ARMSTRONGS MOVES.—Supermarine's Trowbridge works are to be closed down this year and the work transferred to the main factory at South Marston near Swindon. The company's Hursley Park headquarters near Winchester is also to be closed later this year and personnel are being transferred to South Marston and to Hurn.



AT MALVERN.—Under test at the Royal Radar Establishment is this infra-red homing head for a research missile. It is described on page 617.



VICKERS TANKER.—For inspection by H.R.H. The Duke of Edinburgh at Wisley on April 25 was a Valiant tanker and probe-equipped Scimitar naval strike fighter.

NAVAL ELECTRAS.—A research and development contract is shortly to be placed with Lockheed for production of a version of the Electra turboprop airliner for the U.S. Navy. The naval version will carry a crew of 10 and be powered by Allison T56 turboprops. It will eventually replace the Lockheed Neptune.

Next Week

FOLLOWING the first flight of the D.H. Comet 4 on April 27—it is illustrated on page 608—the issue of THE AEROPLANE dated May 9 will contain a specially prepared article about this British turbojet airliner.

SURVIVORS' STORY.—Flt. Lt. J. de Salis and Flg. Off. P. Lowe, who recently ejected from the record height of 56,000 ft., have given some details of their 4¼-min. free fall, to about 10,000 ft. The drogue stabilizer on Flt. Lt. de Salis' parachute fouled a piece of wreckage, and he whipped into a violent spin. The amount of *g* developed in this spin was enough to prevent him lowering his arms from above his head, and caused hæmorrhages from his eyes, ears and mouth. He was incapable of opening his parachute, but the barometric release worked perfectly. Flg. Off. Lowe had a relatively comfortable descent, except for watching his gloveless hands become covered with frost in the air temperature of −65° F.

MORE LABOURS.—Two Lockheed C-130A Hercules turboprop transports are to be converted for launching missile target drones, carrying two under each wing. They will be tested at Holloman A.F.B., New Mexico, and Eglin A.F.B., Florida. More than 160 Hercules are now in service with the U.S.A.F.

MONTHLY SATELLITE.—A U.S. Defence Department official has said that the U.S. is considering launching a satellite once a month as from January, 1959.

Commercial Aviation Affairs

IRISH INAUGURAL.—The inaugural service of the new Irish transatlantic airline, Aerlinte Eireann, left New York on the evening of April 25. Unfortunately, the Seaboard and Western L-1049H, with 79 passengers on board, including the Mayor of New York, suffered engine trouble and was put down at Gander. The passengers were left there while the Super Constellation was ferried back to New York for an engine change.

SERVICES APPROVED. — The M.T.C.A. has approved the operation of three new normal scheduled services. B.E.A. have approval for a service from London to Zürich or Geneva—Belgrade, and/or Athens, and/or Tel Aviv, and/or Istanbul, and/or Beirut. Eagle Airways will be permitted to operate their Manchester-Brussels-Frankfurt service until June 19, 1963, and Eagle Aviation are licensed until March 28, 1960, for a service from Blackbushe or London Airport to Strasbourg.

707 NOISE LEVELS.—The M.T.C.A. is sending a team of specialists to Seattle to measure the noise levels of the Boeing 707 fitted with the company's own noise suppressors. Specialists from the Port of New York Authority and the Paris airport authorities will also make tests.

300th VISCOUNT.—On April 24 the 300th Viscount was officially handed over at Wisley ; it is a Viscount 804, the third purchased by Transair, Ltd. In the picture, left to right, are Mr. H. P. Ruffell, of Vickers' civil aircraft contracts department; Mr. W. Richardson, chief inspector, Transair; Mr. G. H. Freeman, managing director, Transair, and Mr. B. McCall Wilson, Viscount 804 project engineer.

707 CERTIFICATION.—On April 16 C.A.A. and Boeing test pilots began certification flights on the Boeing 707. At that time, the first two production 707s had accumulated 129 hr. 1 min. in the air. They will be joined by the third 707 in the C.A.A. certification programme, with a target date or completion in the autumn of this year.

IRAQ PURCHASE.—To meet the proposed expansion of services, Iraqi Airways have applied for a loan of £600,000 with which to buy three more aircraft. They are understood to be a fifth Viscount and two Herons.

NEW AIRLINE.—Recently formed in Costa Rica is Aerolineas Nacionales which will operate certain specified local as well as international flights. It is reported to be owned and managed by a former director of LACSA.

ALISA IN ISRAEL.—A new company, Alisa, jointly owned by the Israel Government and M. J. Szydlowski (chairman of the Turboméca engine company) has been formed in Israel to encourage development of helicopter transport services. Four Alouette II turbine helicopters are to be imported and will be leased to Arkia (Israel Inland Airlines) to operate a passenger service between Jerusalem and Tel Aviv and for general charter and utility flying.

MEXICAN DEAL.— Aeronaves de Mexico are negotiating with Guest Aerovas to purchase the latter company's rights on the Mexico-Miami-Azores-Lisbon-Paris-Rome route.

DOPPLER DEMONSTRATION.—Between April 28 and May 7 the Marconi company planned to demonstrate its civil Doppler navigator at various European centres. The navigator has been installed in a Viking and the demonstration tour, calling at Paris, Rome, Zürich, Cologne, Hamburg, Stockholm, Amsterdam and Brussels, will be the first in the World with this type of equipment.

QANTAS ECONOMY.—Qantas has introduced economy-class fares for passengers flying between London and San Francisco. These fares are not available for passengers to and from Australia.

K.L.M. ATLANTIC FIGURES.—During 1957 K.L.M. carried 91,000 passengers across the North Atlantic—or 21,000 more than in 1956. The operator's share in the traffic rose to 8.9% from 8.4%.

MID-AIR COLLISION.—A DC-7 of United Airlines operating a scheduled stopping service from Los Angeles to New York crashed near Las Vegas on April 21 after it had been in collision with a Super Sabre of the U.S.A.F. The collision occurred at 21,000 ft. and the Super Sabre is reported to have been descending with engine trouble. All occupants of both aircraft, comprising 36 regular passengers, five United airline employees, five crew and the two pilots in the Super Sabre, were killed.

News About People

A.D.A. NEW PRESIDENT.—Mr. S. E. Clotworthy, managing director of the Northern Aluminium Co., Ltd., has been elected president of the Aluminium Development Association for 1958-59. Dr. Maurice Cook, chairman of I.C.I. Metals Division, has been elected vice-president.

AIRCRAFT EMPLOYMENT. — In January 256,400 people were employed in the manufacture and repair of aircraft, according to the Ministry of Labour. The previous month's total was 257,600. The January figure was first exceeded in peace-time in September, 1956, with 257,300.

RHODESIAN POST.—Air Cdre. Edward W. S. Jacklin, C.B.E., A.F.C., C.A.S. of the R.R.A.F., has been promoted Air Vice-Marshal, thus becoming that Service's first A.V.M. He has commanded the Air Arm in Rhodesia since March 1, 1949.

BLACKBURN VISIT. — When the Fifth Sea Lord, Admiral M. L. Power, and Admiral A. N. C. Bingley, visited Thurleigh to inspect the N.A.39 strike aircraft on April 25 they were accompanied by Admiral R. D. Pirie and Admiral D. L. Austin of the U.S.N. The party was met by Mr. Eric Turner and Capt. E. D. G. Lewin, and they discussed the N.A.39 with its designer, Mr. B. P. Laight and other technicians of the firm.

M.T.C.A. APPOINTMENT. — Mr. R. W. Elliott, M.P., has been appointed Parliamentary Private Secretary to M.T.C.A.'s joint Parliamentary Secretaries—Mr. Richard Nugent, J.P., and Mr. Airey Neave, D.S.O., O.B.E., M.C., T.D.

LEAVING DERBY.— Mr. Willoughby Lappin, whose retirement from Rolls-Royce is reported on page 607.

Military Aviation Affairs

AUSTRIAN WHIRLWINDS.—The first four of six Westland Whirlwinds for the Austrian Air Force were to be handed over on April 29. Col. Gustav Hauck (left), chief helicopter pilot and instructor of that Service, has been at Yeovil on a familiarization course.

ADEN AIR ACTIVITY.—Following the recent fighting by rebel tribesmen on the Dhala-Qataba border, 80 miles north of Aden, M.E.A.F. aircraft have been employed in support of Government ground forces. Last week-end Valettas of No. 84 Sqn. dropped supplies to the besieged fort at Assarir, and No. 8 Sqn. Venoms made rocket attacks on rebels in the surrounding mountains. These attacks were followed by Shackletons of No. 37 Sqn. which dropped 20-lb. anti-personnel bombs on the tribesmen.

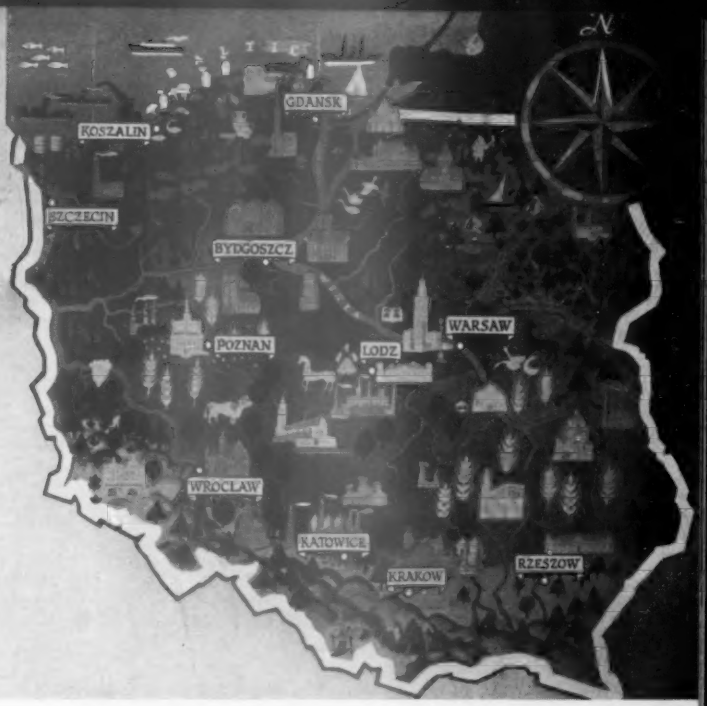
MISSILE TRAINING SCHOOL.—The Douglas Aircraft Co., Inc., is to operate a school at Tucson for training military personnel to handle the Thor IRBM which it is producing for the U.S.A.F. and R.A.F. In addition to Strategic Air Command personnel, it is expected that a substantial number of R.A.F. groundcrew will receive training at Tucson.

PAKISTAN QUEST. — Air Vice-Marshal Asghar Khan, the C.-in-C. of the P.A.F., and Gen. Mohammad Ayub Khan, Commander of the Pakistan Army, are at present visiting Great Britain, and will later travel to the U.S. A.V.M. Khan's visit has been linked with a report that the P.A.F. wants jet bombers to offset the English Electric Canberras of the Indian Air Force.

SWISS TIGERS?—The Grumman Aircraft Engineering Corpn. is expecting to sell a substantial number of F11-1F Super Tigers to Switzerland. The Japanese Defence Agency recently ordered 300.

MIDDLE EAST AIRLIFT.—Last week R.A.F. Transport Command flew 700 men of the Yorkshire and Lancashire Regiment to Aden and Nairobi in two days.

Four Hours to Warsaw



FOLLOWING the arrival in London of the inaugural service by the Polish national airline LOT (THE AEROPLANE, April 18), a return trip was made by B.E.A. For the purpose of record it should be noted that the London-Warsaw service, which is flown direct by B.E.A. in 3 hr. 50 min., was opened on April 8. LOT began its service one day later.

On April 20 B.E.A. made an inaugural flight with a party of distinguished guests in which the Polish party was headed by His Excellency the Polish Ambassador, Mr. Milnikiel. The British party was headed by Mr. Airey Neave, M.P., Parliamentary Secretary to the Ministry of Transport and Civil Aviation. The Foreign Office was represented by Sir William Hayter, Deputy Under-Secretary of State at the Foreign Office, who was accompanied by Lady Hayter. Sir Arnold Overton, of the B.E.A. board, was accompanied by Lady Overton.

Representatives of the Press and travel agents together with executives of B.O.A.C. and B.E.A. made up the party.

Under the command of Capt. C. A. Owens, assistant flight manager, No. 1 Viscount Flight (B.E.A./L.A.P.), the trip began under bright sun. Unfortunately, it was not possible to see Copenhagen, and great though the interest was to catch the first sight of Poland, nothing was visible until the Viscount came out of cloud at around 800 ft. and the flat agricultural plain around Warsaw with scattered small dwellings was revealed. It was clear from the state of the fields and not least from the standing pools of water that the snow had not long been melted. This was confirmed by Gp. Capt. R. E. Ridgway, our Air Attaché, who came to greet the party.

Warsaw airport at Okecie (pronounced Okenchay) is small, with the triangular runway arrangement familiar from wartime airfields. The buildings are topped with the big scanning dish of the P.P.I. radio now being installed. ILS facilities are not available: one gathered that there are some difficulties to do with the airborne installation.

The party was swept into a reception hall and soon ushered into a Leyland 50-seater, of which Poland has 100 or so. Driving along a pavé road with plenty of mud around, and rebuilding, it was not long before big blocks of flats, built of bricks very often recovered from ruins, were conspicuous. They are left unpointed. This would be all right if the buildings were later covered with plaster, but this had been left off for economy reasons and consequently the buildings are proving extremely costly to heat.

Dominating the skyline of Warsaw is the Palace of Culture designed and built by the Russians. To the tip of the television mast is around 500 ft. and the enormous edifice, equivalent to flats for 40,000, was built on super priority.

Very generous accommodation was waiting at the Hotel Bristol and was kept available for each member of the party throughout the stay, but there was hardly time to take advantage of the bathrooms before we were whisked off to a reception. This was held in a palace which looked very much as it had when built in the early nineteenth century, but in point of fact it had been very heavily damaged during the War and had been rebuilt.

The party then had a banquet in a train, splendid in mahogany and furnishings to match. An extremely smooth if leisurely journey, with what seemed frequent halts to allow other trains to pass on the single-track line, followed. By the time the party was up and having breakfast the countryside had changed and given way to a more rolling terrain. On one low hill snow was still lying on a southward-facing slope.

Cracow is dominated, not by a newly built Russian palace but by the ancient citadel of Wavel, where the many-domed baroque cathedral huddles against a palace with the largest courtyard in Europe and in it is housed an extensive collection of pictures and a unique Leonardo da Vinci.

After a banquet we were hurried away, with a detour past the new steel works at Nowa Huta, to the salt mines at Wieliczki. Here in the vast underground caverns, we were shown traces of the installations put in by the Germans to build V.2s.

At dinner that evening Mr. Airey Neave delivered part of his address in Polish which our Polish hosts were able to follow with ease.

Next day the party was interested in their flight back to Warsaw in two Il-14s. These examples of the German-built Russian design were impressive for their competent external finish if somewhat rugged interior. We all thought how pleasant to find only 26 seats arranged in pairs on each side of a wide gangway. These machines are pulled nose-up early in the take-off and seem to climb as steeply as the Convair 240. The big radials did not prove as noisy as one expected.

After lunch in the Bristol Hotel the party went shopping or window-shopping but one technically minded member was taken back to the airport where he was in time to make a cursory inspection and to see the arrival of the B.E.A. Viscount and to see Mr. Cavanagh, the resident B.E.A. representative in action. One hour and a half later we were awaiting the stragglers for a farewell cocktail party given by His Excellency the British Ambassador who had flown up from Cracow with us.

Early next day we were off to Okecie once again. Farewells were said and we had a bumpy flight in and out of cloud at the top of an inversion. For the return we flew back with LOT in a Convair 240.

East Berlin Airport was green and large and not very busy. A helicopter could be seen on the ground and there were numerous Il-14s around. Among them were two Commandos with Fred Olsen markings. There were also a number of Czechoslovak Brigadyrs with crop-dusting equipment. There was not much traffic during our 40 minutes' stay.

Climbing above the cloud into sunshine we rumbled along in the comfortably spaced paired seating of the Convair 240 which aeroplane is remarkable for the fact that the farther forward one goes the less noisy it gets. On this leg we were served with a cold lunch.

Brussels was a seething hive of activity. Flags fluttering in the sun, the big Sikorsky helicopters shuttling to the exhibition and the ceremonial departure of the Japanese princess who had been opening her country's pavilion.

It is hardly necessary to state that once down at L.A.P. the ceremonial part of the trip came abruptly to an end as we were sternly bidden to read the intimidating customs boards and declare what we had bought. How happy our hosts would have been if they had had a lot more to sell us!—T.J.

AIR TRANSPORT

Co-ordinating Airworthiness Requirements

FOLLOWING the meeting in Washington last December, British and American specialists met again in London last week for further discussions about the two national airworthiness codes. Mr. Walter Tye, Chief Technical Officer of the A.R.B., was in the chair and the 16-strong U.S. team was led by Mr. W. E. Koneczny, chief of C.A.B. Airworthiness Division.

The December meetings had explored performance requirements for turbine-engined transports and had shown that there was a good prospect of eliminating, or at least of materially reducing, the differences between the rules and practices of the two countries. Since then the A.R.B. and C.A.B. have each been re-examining the codes and have prepared draft revisions. Last week's meetings provided the opportunity for each side to assess the merits of the two revisions before reaching final conclusions.

The British team at the meetings included representatives of Government departments, the S.B.A.C., airline operators, the British Air Line Pilots Association and the A.R.B. The U.S. team included representatives from Boeing, Lockheed, Convair and Fairchild; from United Air Lines, American Airlines and Pan American Airways; and from the Air Transport Association, the Air Line Pilots Association and the Airways Modernization Board.

The Battle of the Bun

HISTORY appears to be repeating itself in the matter of the level of permissible discomfort in economy class air travel. Just as in the early period after the introduction by IATA carriers of the tourist class in 1952, so, in 1958, there seem to be difficulties about the number of currants in a free bun—or, to be more factual, about the legal constitution of a "sandwich."

When tourist fares were introduced it was agreed that there should be no free drinks and that meals should be "simple and inexpensive." The airlines began, no doubt, with the best of intentions, but the tourists' meals have become indistinguishable from those served in more luxurious flying environments.

Now, in 1958, various European carriers appear to have been accused of cheating over the standards of the free sandwiches permitted on economy-class flights and, in one case, of selling (in the transit lounge at an airport) a "liquor kit."

Some sympathy can be felt for the honest (or less imaginative?) carriers when they learnt that (according to *Aviation Daily*) another carrier's sandwich consisted of "an invisible piece of bread upon which there were placed three slices of roast beef, one large slice of smoked salmon and two large slices of ham."

That is, perhaps, going a bit far in the competitive revision of the definition of a sandwich. But very little sympathy can be felt for the objector to the "liquor kit." There is surely nothing to prevent an economy-class passenger from carrying aboard a flask of brandy, which will almost certainly have been bought at an airport of departure or transit. Why should not the carrier make a little profit out of this supply?

After examining the background against which the economy service came into being and the various agreed conditions, an IATA commission has now declared that the meal service should be on the following lines:—

"(a) Meals to consist of sandwiches, which may be of the 'open' or 'closed' variety; (b) each sandwich to be a separate unit, the whole meal not to give the appearance of a cold plate; (c) a substantial and visible part of each unit to consist of bread, roll, or similar bread-like material; (d) each unit to be cold; (e) each unit to be simple, i.e. not complicated; unadorned. This calls for a minimum of garnishing; and (f) each unit to be inexpensive. This calls for avoidance of materials normally regarded as expensive or luxurious, such as (for example, but without limiting) smoked salmon; oysters; caviare; lobster; game; asparagus; paté de foie gras. Also for the avoidance of over-generous or lavish helpings of permissible commodities, such as meats, which affect the money value of the unit and destroy the necessary conditions of low cost and simplicity."

Well, well—this seems to be clear enough. The number of currants in the free bun have now been stipulated.—H.A.T.

Allison-Convair Proposal

ALLISON Division of General Motors Corporation is planning a major sales campaign to introduce its conversion of the Convair 340 and 440 with Allison 501-D13 turboprops. The modification has been engineered by Allison, using data supplied by Convair; actual conversions would be undertaken by an aircraft company.

According to *Aviation Daily*, the cost of Allison conversions will be $480,000 per aircraft, of which about half will be the cost of the engines and propellers. The whole powerplant is that used in the Electra and two of these engines in the Convair YC-131C recently completed a 1,000-hour reliability test.

In fostering Convair conversions to turboprop power, Allison are following a path already worn smooth by Napier. The Napier Eland-Convair conversion has so far been adopted by only one airline, Real Aerovias of Brazil, but these engines have also been adopted for the Canadair 540 (CL-66). Although starting later, Allison seem to have the advantage that their engine is already established in production and backed by many thousands of flight hours, and will become increasingly used throughout the U.S.A. in the Electra. The Eland is type-tested at 3,500 e.h.p. and the Allison 501D-13 at 3,750 e.h.p.

WARSAW TURN-ROUND.—As discussed on the previous page services between London and Warsaw are being operated by B.E.A. and LOT. Here is the B.E.A. Viscount arriving at 4.15 p.m. local time on April 22. Seventy-five minutes are allowed for the turn-round.

Photograph copyright "The Aeroplane"

World Air Transport in 1957

PROVISIONAL 1957 traffic and other results for the World's airlines have now been issued by ICAO as a part of the annual report of that Organization. In general, the traffic results were satisfactory, but the financial results—in so far as these can be assessed—clearly show an unhappy trend.

The principal traffic figures (in millions) for the year were as follows: miles flown, 1,760; passenger-miles, 51,000; passenger ton-miles, 4,940; cargo ton-miles, 1,150; and mail ton-miles, 300. By comparison with 1956, the increases recorded were: passenger-miles, 15.5%; cargo ton-miles, 11.3%; and mail ton-miles, 7.3%. The World's air traffic curves, therefore, continue to maintain their upward trends.

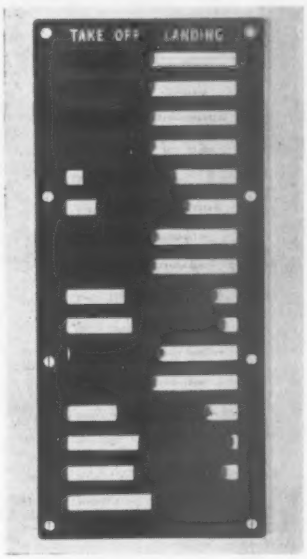
Estimates for the proportions of different classes of passenger traffic on a typical long-haul route—that over the North Atlantic—show that 22% were first-class, 73% were tourist-class, and 5% were passengers on the charter flights of scheduled airlines. The passenger total was 1,018,784—or about 7,000 less than that carried by the shipping companies. These figures do not include the 20,000 or so air passengers carried by non-scheduled operators, or the unknown number of sea passengers carried by tramp steamers.

Only very tentative financial estimates for 1957 are offered by ICAO, since the available information is far from complete, but preliminary estimates suggest that both operating revenues and expenses exceeded $4,000 million for the first time. The operating revenues appear to have been about $4,100 million and the operating expenses about $4,050 million. This indicates an operating ratio (revenue as a percentage of expenses) of only about 101.2 by comparison with the 1956 figure of 102.5—which was itself slightly below the ratio for 1955 (102.6).

The report suggests that the "less favourable" operating results for 1957 were caused, as in the previous two years, by a decline in load factors as well as by increases in costs. The average cost figures (in U.S. cents) for 1957 were as follows (the 1956 figures shown in brackets): unit expenses per available tonne-kilometre, 24.3 (24.0); unit expenses per tonne-kilometre performed, 41.3 (40.0); unit revenues per tonne-kilometre performed, 41.8 (41.0); load factor, 58.3 (59.3).

Cockpit Drill Check Board

A CHECK board which gives positive indication to pilots carrying out their final cockpit drills prior to take-off or landing, has been developed by International Aeradio, Ltd. It can be fixed in the cockpit or carried in the hand, and consists of a metal board with window slots, fitted with slides which move from one side of the window to the other. When in the left-hand half of the window, the slide leaves the right-hand half open—for the "take-off drill."



As each part of the drill is completed the slide is pushed over to the right side of the window. When the complete "take-off drill" has been completed the slides are all in the right-hand position and the check board is then ready with the "let-down drill." These boards are being adopted for the fleet of Middle East Airlines.

Manchester's Runway Extension Opened

THE Government was in partnership with the City of Manchester in the important development which was then being inaugurated, said the Right Hon. Harold Watkinson, M.P., Minister of Transport and Civil Aviation, on Wednesday of last week. He was opening the extension to the main runway and unveiling a plaque to mark the start of the construction of a new terminal building at Manchester Airport, Ringway.

Mr. Watkinson expressed himself as delighted that the longer runway would enable B.O.A.C. to resume operations there almost immediately, but it would be two years before the main building was complete. Designing a terminal, he continued, was a fascinating task, there being few fields that gave more scope for imagination than a major airport. Great care had been taken in providing for the speedy movement of passengers to and from their aircraft. The Government were doing a great deal, at considerable cost, in developing new airports up and down the country.

The Minister returned to the partnership theme at a luncheon given in Manchester Town Hall to celebrate the occasion, saying that he hoped that other municipalities would in due course follow Manchester's lead, taking substantial stakes in their respective airports. Mr. Watkinson expressed thanks to the Americans at Burtonwood for enabling the B.O.A.C. services to be maintained.

He did not believe that they had yet scratched the surface of air transport, especially on the freight side. New jet aircraft were coming and he felt it right that they should go ahead in making Prestwick an alternative for London; at Prestwick it was possible to have the necessary runway extension for the lowest cost. Before finalizing plans for the jet age there was a great deal more thinking to do, especially about such problems as runway length. The difficulty of noise from jets had not yet been solved, this being a question of importance to Manchester Airport, which fringed on a built-up area. Investigations into jet noise suppression were continuing in this country and in America. On the matter of economic policy he felt that the present was not the time to remove the general restraint.

The new runway at Manchester would take any aircraft without a weight penalty and the terminal would form a worthy gateway to the United Kingdom, said Alderman Tom Regan, Airport Committee Chairman, who recalled that the city's first temporary airport building consisted of a Dutch barn at Wythenshawe. During the post-war period the freight handled at Ringway had increased to 57 times the old figure. With the new runway either Britannias or Comets could use their airport immediately. Alderman Regan was anxious to know if the Government had decided that Manchester should be developed to meet the needs of long-haul jet aircraft. If the requirements of these jets were such that the River Bollin would have to be crossed, a project of some magnitude would be involved.

The value of the airport to the wide area around the city was stressed by the Lord Mayor, Alderman Leslie Lever, J.P., M.P., who expressed appreciation of the work of Mr. G. A. H. Harvey, the airport director.

Giving an additional 1,100 ft. at the south-west end, the extension makes the main runway 7,000 ft. long. As the new terminal building will partly overlap the existing premises, most of the latter are to be demolished. The new apron will be flanked by twin piers, one for international and the other for domestic traffic, and will have standings for 22 aircraft. On both piers, and within the building, baggage will be handled at apron level and passengers on the first floor. The concourse, located on the first floor, will be connected to the ground floor by stairs and escalators. Passengers joining aircraft will enter through the traffic hall on the east and those who have arrived will leave through the baggage claim section on the west. Extensive accommodation will be provided for the passengers. The restaurant, cocktail bar, and buffet will overlook the apron, as will the international waiting room and lounge which will be linked to the Customs Hall. Accommodation for spectators will be provided on roof-terraces above the main building and on the roofs of the piers. A model of Ringway's new terminal was illustrated in THE AEROPLANE of April 19, 1957.

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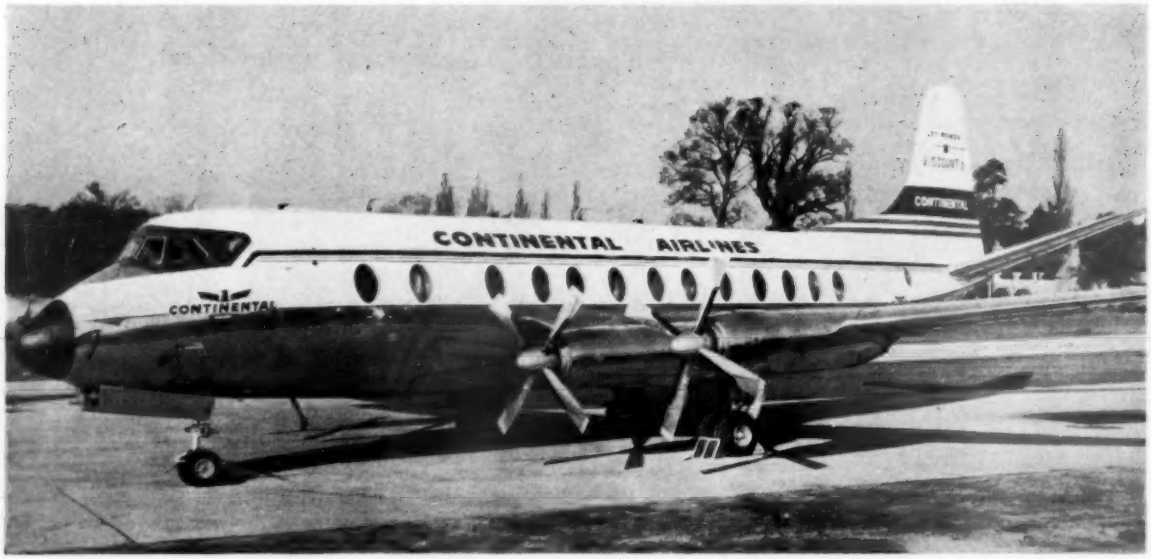
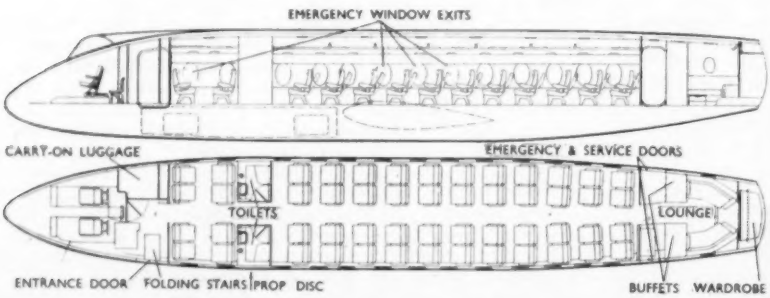


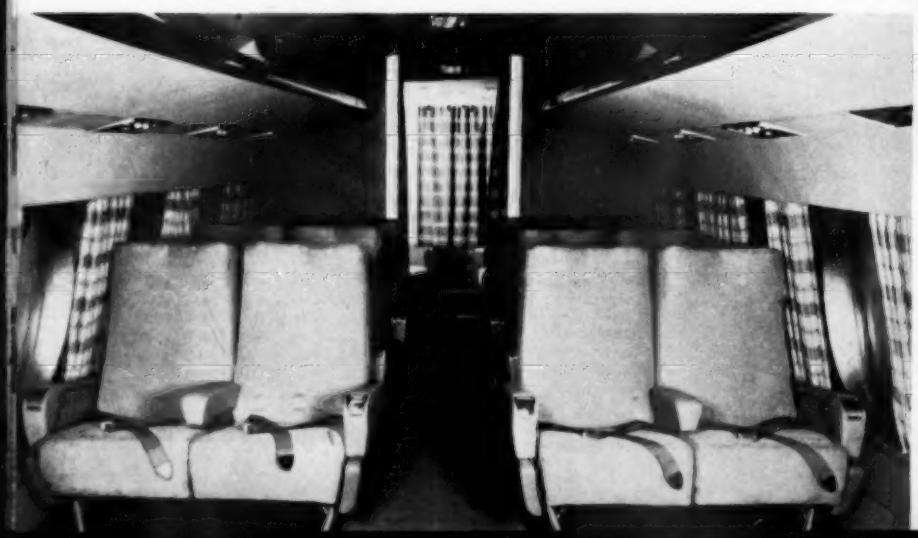
U.S. Certificate for Viscount 810

ON Tuesday of last week Vickers-Armstrongs officially received a C.A.A. Type Certificate for the Viscount 810 Series. The event provides a suitable occasion for illustrating some of the features of the 812 variant of which Continental Airlines, of Denver, Colorado, have 15 on order. Deliveries to Continental are about to begin and the first service, from Los Angeles to Denver, is scheduled for May 28.

As will be seen from the layout plan, Continental's 812 has accommodation for 52 passengers in 13 rows of normal four-abreast seats (each pair with a window) and for four additional passengers in the rear lounge, where the seats are cleared for use on take-off and landing. Another unusual feature of the layout is the eight-passenger forward compartment which is separated by the two toilets from the main cabin. Entry and exit will normally be via the forward door, where there are air stairs and, opposite the entrance, a compartment for "carry-on" luggage. There is a passenger-address speaker for each pair of seats.

The flight deck—which was illustrated in THE AEROPLANE of February 28 (p. 281)—is laid out for two-crew operation and has several new features. Among these is the central engine-panel positioning of the weather-radar display, the





Above, a glimpse of the 812's four-seat rear lounge which can be used either for relaxation in flight, or as a part of the normal accommodation when traffic is heavy. There is wardrobe space behind the curtains.

Left, an impression of the passenger cabin of the 812, looking towards the rear lounge. The design of this pleasant and roomy interior has been the work of Charles Butler.

"double" torquemeters and the new Collins 105 director horizon and beam compass. Powerplant operating features are the "high-stop" cruise pitch locks for the propellers—necessary because of the higher power and cruising speed of the 810 Series—and the use of a manual ground fine pitch selector in place of oleo-tripped micro-switches. Another feature in the control cabin is an ingenious new gust-lock system which, when engaged, prevents more than any two of the four throttles from being opened together and also prevents the selection of flight fine pitch.

U.S. Airline Growth

SEVERAL significant trends are shown in the A.T.A. "Air Transport Facts and Figures" covering the results of the American air transport industry in 1957. For the first time ever, the airlines operated more passenger miles (over 25,000 million) than the railroads (about 21,000 million) in domestic intercity operations. The railroad figures exclude commuter travel within cities; the airline figures include domestic trunk, local service and helicopter operations. Railroad traffic has declined rapidly since its peak in 1944 of 90,000 billion, while air traffic figures have been increasing steadily since 1938 with the exception of a small set-back in 1948.

In 1957, scheduled U.S. airlines carried 49.4 million passengers and completed 31,243 million revenue passenger-miles, 160.7 million mail ton-miles and 507.7 freight ton-miles. The last domestic trunk line came off subsidy in 1957. Whereas, in 1938, 42.1% of the total U.S. airline revenue was from the government, in 1957 only 3.1% of the total was accounted for by service mail pay and another 1.9% by public service revenues.

Flying in the U.S.A. also became safer during the year, with passenger fatalities down to 0.2 per 100 million passenger miles. In 1956, passenger fatalities in cars and taxis were at the rate of 2.7 per 100 million passenger miles.

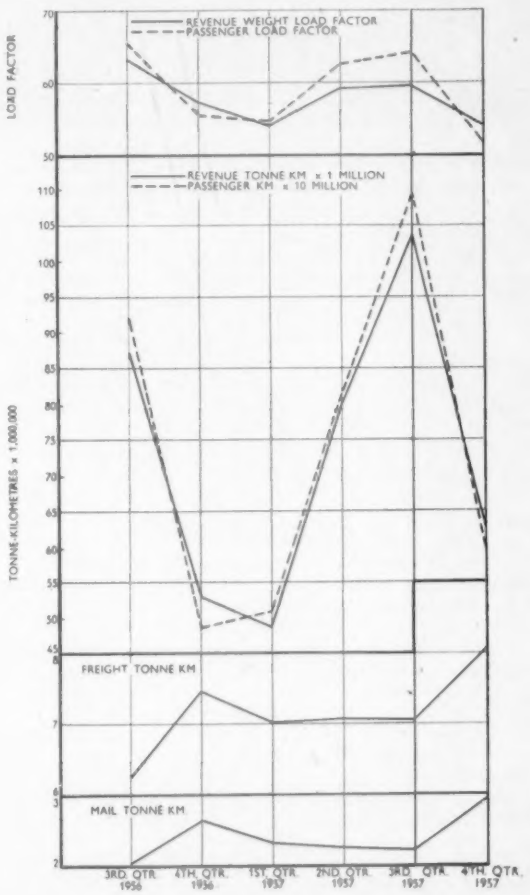
The A.T.A. report records that foreign airlines are taking an ever-increasing share of the U.S. market, and that U.S. flag lines in 1957 carried only just over 60% of all traffic between America and foreign countries compared to more than 75% in 1949. On the other hand, the percentage of all passengers who are U.S. citizens, continues to increase. Since 1949, the number of foreign airlines serving the U.S.A. has increased from 22 to 39 and the A.T.A. report comments on the granting during 1957 of "valuable air routes" to K.L.M. and Qantas, saying this was "contrary to the spirit of the U.S. bi-partisan air transport policy."

European Traffic Trends

TABULATED below are selected statistics showing the results of certain European airlines in the fourth quarter of 1957. They are a continuation of the figures published in our issue of January 31, 1958, which dealt with the operations of these airlines in the five preceding quarters. Results for Air France are included in this issue for the first time.

The statistics are largely self-explanatory, and show that these airlines continued, for the most part, to make the expected progress. Lufthansa, once again, recorded a quite dramatic expansion compared with the same quarter of 1956, while the Aer Lingus results continued to reflect the ending of their monopoly on the London-Dublin route.

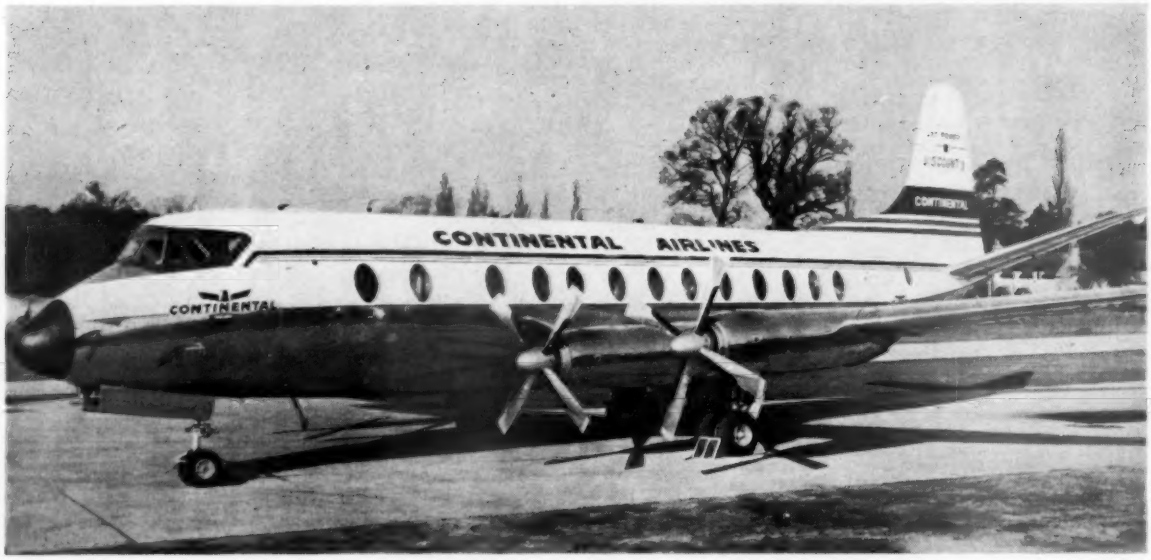
The curves, alongside, show the overall trends on the basis of results of nine operators (including estimates for Alitalia-L.A.I. and Iberia). The Air France figures are not included in these totals, which are not in themselves significant but serve to indicate progress in general. Although revenue tonne-kilometres and passenger-kilometres flown showed a healthy increase over the same period of 1956, the average revenue weight and passenger load factors for these airlines fell a little, indicating that the growth in traffic has not kept pace with growth in capacity offered. Load factors in general throughout 1957 appear to have been a little lower than is generally desirable.



The trend of European traffic over the past 18 months is shown in these curves, based on the quarterly results for Aer Lingus, Alitalia, B.E.A., Finnair, Iberia, Lufthansa, Sabena, Swissair and T.A.P.

	4th qtr. 1957	4th qtrs. %change	4th qtr. 1957	4th qtrs. %change	4th qtr. 1957	4th qtrs. %change	4th qtr. 1957	4th qtrs. %change
	AER LINGUS		AIR FRANCE		B.E.A.		FINNAIR*	
Passengers carried	70,792	−4.5	206,388	—	486,913	+12.9	87,000	+ 4.0
Passenger L.F.%	59.3	—	64.0	—	62.0	—	49.3	—
Passenger-km. (1000)	27,998	−0.7	116,801	—	270,071	+16.4	38,000	+10.5
Freight tonne-km.	453,969	+0.8	1,234,290	—	3,830,784	+ 5.8	320,000	− 6.0
Mail tonne-km.	120,543	+4.5	279,292	—	1,521,693	− 3.9	132,000	+ 5.9
Total tonne-km. (1000)	2,905	+0.1	11,540	—	28,632	+13.0	3,700	+ 7.3
Revenue L.F.%	59.4	—	57.0	—	60.4	—	59.6	—
	LUFTHANSA		SABENA		SWISSAIR		T.A.P.*	
Passengers carried	56,000	82.4	76,264	+13.8	156,316	+25.8	7,650	+18.2
Passenger L.F.%	50.1	—	40.3	—	53.8	—	51.0	—
Passenger-km. (1000)	28,416	46.8	49,863	+20.3	83,183	+29.0	6,000	+11.6
Freight tonne-km.	266,236	33.9	1,250,601	− 3.0	1,103,597	+45.9	34,000	+ 6.5
Mail tonne-km.	106,175	53.0	185,995	+ 5.3	416,854	+36.9	23,000	− 1.5
Total tonne-km. (1000)	2,916	45.0	6,075	+14.4	9,125	+31.6	660	+21.4
Revenue L.F.%	42.0	—	49.0	—	51.2	—	43.0	—

* Approximate figures.

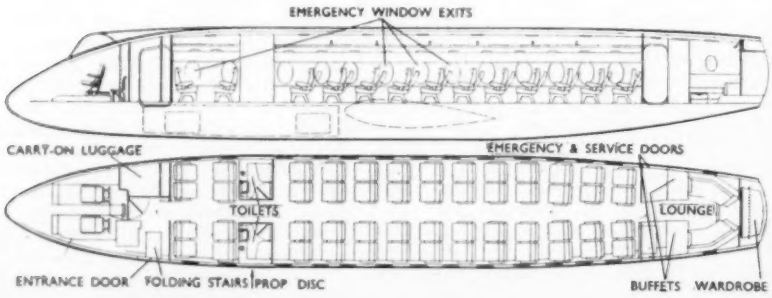


U.S. Certificate for Viscount 810

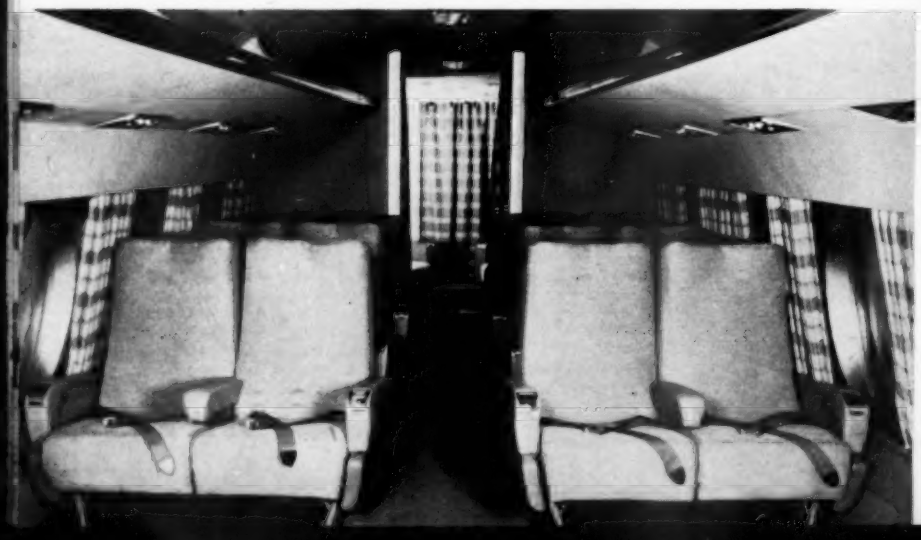
ON Tuesday of last week Vickers-Armstrongs officially received a C.A.A. Type Certificate for the Viscount 810 Series. The event provides a suitable occasion for illustrating some of the features of the 812 variant of which Continental Airlines, of Denver, Colorado, have 15 on order. Deliveries to Continental are about to begin and the first service, from Los Angeles to Denver, is scheduled for May 28.

As will be seen from the layout plan, Continental's 812 has accommodation for 52 passengers in 13 rows of normal four-abreast seats (each pair with a window) and for four additional passengers in the rear lounge, where the seats are cleared for use on take-off and landing. Another unusual feature of the layout is the eight-passenger forward compartment which is separated by the two toilets from the main cabin. Entry and exit will normally be via the forward door, where there are air stairs and, opposite the entrance, a compartment for " carry-on " luggage. There is a passenger-address speaker for each pair of seats.

The flight deck—which was illustrated in THE AEROPLANE of February 28 (p. 281)—is laid out for two-crew operation and has several new features. Among these is the central engine-panel positioning of the weather-radar display, the



Above, a glimpse of the 812's four-seat rear lounge which can be used either for relaxation in flight, or as a part of the normal accommodation when traffic is heavy. There is wardrobe space behind the curtains.



Left, an impression of the passenger cabin of the 812, looking towards the rear lounge. The design of this pleasant and roomy interior has been the work of Charles Butler.

"double" torquemeters and the new Collins 105 director horizon and beam compass. Powerplant operating features are the "high-stop" cruise pitch locks for the propellers—necessary because of the higher power and cruising speed of the 810 Series—and the use of a manual ground fine pitch selector in place of oleo-tripped micro-switches. Another feature in the control cabin is an ingenious new gust-lock system which, when engaged, prevents more than any two of the four throttles from being opened together and also prevents the selection of flight fine pitch.

U.S. Airline Growth

SEVERAL significant trends are shown in the A.T.A. "Air Transport Facts and Figures" covering the results of the American air transport industry in 1957. For the first time ever, the airlines operated more passenger miles (over 25,000 million) than the railroads (about 21,000 million) in domestic intercity operations. The railroad figures exclude commuter travel within cities; the airline figures include domestic trunk, local service and helicopter operations. Railroad traffic has declined rapidly since its peak in 1944 of 90,000 billion, while air traffic figures have been increasing steadily since 1938 with the exception of a small set-back in 1948.

In 1957, scheduled U.S. airlines carried 49.4 million passengers and completed 31,243 million revenue passenger-miles, 160.7 million mail ton-miles and 507.7 freight ton-miles. The last domestic trunk line came off subsidy in 1957. Whereas, in 1938, 42.1% of the total U.S. airline revenue was from the government, in 1957 only 3.1% of the total was accounted for by service mail pay and another 1.9% by public service revenues.

Flying in the U.S.A. also became safer during the year, with passenger fatalities down to 0.2 per 100 million passenger miles. In 1956, passenger fatalities in cars and taxis were at the rate of 2.7 per 100 million passenger miles.

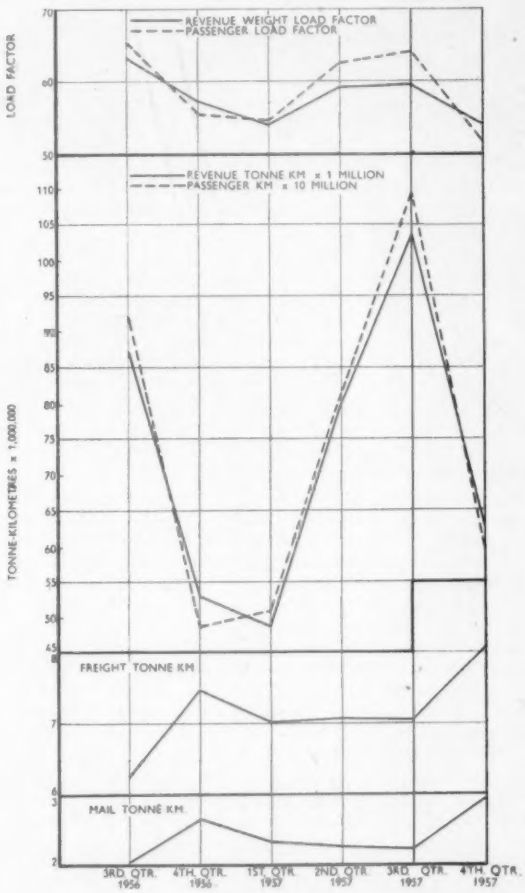
The A.T.A. report records that foreign airlines are taking an ever-increasing share of the U.S. market, and that U.S. flag lines in 1957 carried only just over 60% of all traffic between America and foreign countries compared to more than 75% in 1949. On the other hand, the percentage of all passengers who are U.S. citizens, continues to increase. Since 1949, the number of foreign airlines serving the U.S.A. has increased from 22 to 39 and the A.T.A. report comments on the granting during 1957 of "valuable air routes" to K.L.M. and Qantas, saying this was "contrary to the spirit of the U.S. bi-partisan air transport policy."

European Traffic Trends

TABULATED below are selected statistics showing the results of certain European airlines in the fourth quarter of 1957. They are a continuation of the figures published in our issue of January 31, 1958, which dealt with the operations of these airlines in the five preceding quarters. Results for Air France are included in this issue for the first time.

The statistics are largely self-explanatory, and show that these airlines continued, for the most part, to make the expected progress. Lufthansa, once again, recorded a quite dramatic expansion compared with the same quarter of 1956, while the Aer Lingus results continued to reflect the ending of their monopoly on the London-Dublin route.

The curves, alongside, show the overall trends on the basis of results of nine operators (including estimates for Alitalia-L.A.I. and Iberia). The Air France figures are not included in these totals, which are not in themselves significant but serve to indicate progress in general. Although revenue tonne-kilometres and passenger-kilometres flown showed a healthy increase over the same period of 1956, the average revenue weight and passenger load factors for these airlines fell a little, indicating that the growth in traffic has not kept pace with growth in capacity offered. Load factors in general throughout 1957 appear to have been a little lower than is generally desirable.



The trend of European traffic over the past 18 months is shown in these curves, based on the quarterly results for Aer Lingus, Alitalia, B.E.A., Finnair, Iberia, Lufthansa, Sabena, Swissair and T.A.P.

	4th qtr. 1957	4th qtrs. %change	4th qtr. 1957	4th qtrs. %change	4th qtr. 1957	4th qtrs. %change	4th qtr. 1957	4th qtrs. %change
	AER LINGUS		AIR FRANCE		B.E.A.		FINNAIR*	
Passengers carried	70,792	−4.5	206,388	—	486,913	+12.9	87,000	+ 4.0
Passenger L.F.%	59.3	—	64.0	—	62.0	—	49.3	—
Passenger-km. (1000)	27,998	−0.7	116,801	—	270,071	+16.4	38,000	+10.5
Freight tonne-km.	453,969	+0.8	1,234,290	—	3,830,784	+ 5.8	320,000	− 6.0
Mail tonne-km.	120,543	+4.5	279,292	—	1,521,693	− 3.9	132,000	+ 5.9
Total tonne-km. (1000)	2,905	+0.1	11,540	—	28,632	+13.0	3,700	+ 7.3
Revenue L.F.%	59.4	—	57.0	—	60.4	—	59.6	—
	LUFTHANSA		SABENA		SWISSAIR		T.A.P.*	
Passengers carried	56,000	82.4	76,264	+13.8	156,316	+25.8	7,650	+18.2
Passenger L.F.%	50.1	—	40.3	—	53.8	—	51.0	—
Passenger-km. (1000)	28,416	46.8	49,863	+20.3	83,183	+29.0	6,000	+11.6
Freight tonne-km.	266,236	33.9	1,250,601	− 3.0	1,103,597	+45.9	34,000	+ 6.5
Mail tonne-km.	106,175	53.0	185,995	+ 5.3	416,854	+36.9	23,000	− 1.5
Total tonne-km. (1000)	2,916	45.0	6,075	+14.4	9,125	+31.6	660	+21.4
Revenue L.F.%	42.0	—	49.0	—	51.2	—	43.0	—

* Approximate figures.

THE FIGHTING SERVICES

No. 11 Group Memorial

A STONE plaque above the site of the underground operations room at the Headquarters of No. 11 Group, Uxbridge, was unveiled by Air Chief Marshal Lord Dowding, G.C.B., G.C.V.O., C.M.G., R.A.F. (Retd.), on April 22. No. 11 Group is shortly moving to R.A.F. Martlesham Heath, Suffolk, and the old operations room, which was the nerve centre of Fighter Command during the Battle of Britain when Lord Dowding was A.O.C.-in-C., is to become a Service telephone exchange.

After the unveiling of the memorial, made from a boulder of Cornish grey granite and bearing the badge of No. 11 Group, Fighter Command, a Hurricane and Spitfire from R.A.F. North Weald flew overhead and Lord Dowding, accompanied by the A.O.C.-in-C., Fighter Command, Air Chief Marshal Sir Thomas Pike, and the A.O.C., No. 11 Group, Air Vice-Marshal V. S. Bowling, visited the centre for the last time. For this occasion it was fully manned by personnel from a number of stations and as far as possible the events of Sunday, September 15, 1940, were reconstructed.

On that day an early warning of the concentration of German aircraft near Calais allowed the duty controller to couple 10 squadrons into wings and bring reinforcements from adjacent groups before the first enemy raid crossed the coast. As a result, the enemy force was heavily and continuously engaged during the attack and suffered heavy losses. Guests at the simple ceremony included Air Chief Marshal Sir Hugh Saunders, A.O.C., No. 11 Group, from the end of 1941 until 1944; Air Vice-Marshal S. D. MacDonald, a former A.O.C., No. 11 Group, and Air Vice-Marshal S. F. Vincent, who commanded Northolt and North Weald during the battle.

Photographs copyright "The Aeroplane"

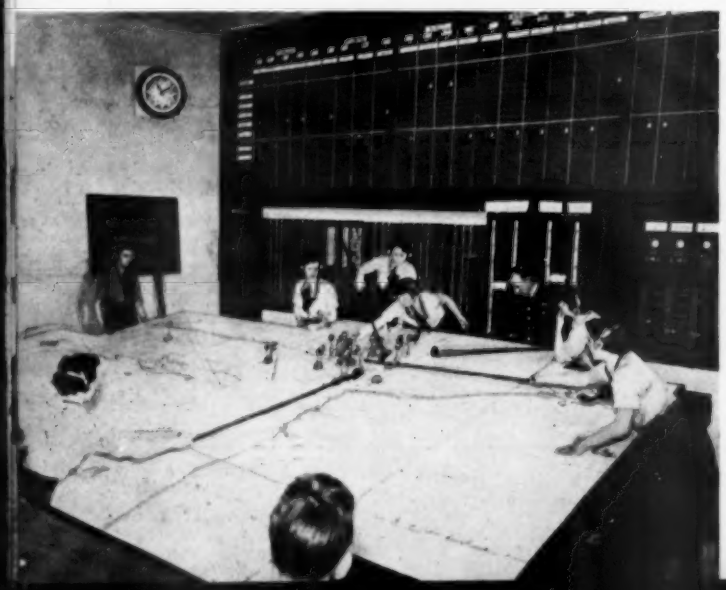
As recorded on this page, Air Chief Marshal Lord Dowding visited the Headquarters of No. 11 Group at Uxbridge last week. Above, Lord Dowding unveiling the memorial plaque over the old operations room and, below, the reconstructed wartime scene in the fighter control centre.

A Record Reunion

SQUADRON reunions can sometimes be perfunctory affairs, but no one could apply that label to the 41st annual dinner of No. 46 Squadron, held on April 12 at R.A.F. Station, Odiham.

No fewer than 90 past and present members of the Squadron (one of them, an American, R. Viall, came over especially from the States) sat down to a long and lively dinner. In the chair was the Squadron's first C.O., Air Marshal Sir Philip Babington, ably seconded by the present C.O., Wg. Cdr. Harry White, and of course, by Capt. ("Chaps") Marchant, M.C.

It is without precedent for any R.A.F. squadron to have held 41 annual reunions without a break, and the credit for building up this record year after year goes entirely to that indefatigable inspirator, Capt. Marchant. Now, owing to illness, he has had to drop the reins, but fortunately there was a member of the present Squadron keen and ready to take them over. That was Flt. Lt. Peter Gifkins, who with the active support of Wg. Cdr. White, staged for us one of the outstandingly successful reunions of recent years.—A.S.G.L.



R.A.A.F. Overseas Postings

A NUMBER of changes in R.A.A.F. overseas appointments have been announced by the Australian Department of Air. Gp. Capt. K. S. Hennock, D.F.C., at present Director-General of Personnel at the Department of Air, is to become Australian Air Attaché in Washington on August 18. The new Director-General of Personnel will be Gp. Capt. I. J. Roberts, Senior Air Staff Officer at R.A.A.F. Overseas Headquarters, London.

Gp. Capt. A. D. Henderson, O.B.E., has been appointed to succeed Gp. Capt. Roberts in London and his present post of Director of Air Force Intelligence at Melbourne will be taken over by Gp. Capt. A. E. L. Davies. For the past two years Gp. Capt. Davies has been Australian Defence Representative in New Zealand. Wg. Cdr. M. G. Cowan, D.S.O., is to attend the U.S. Armed Forces Staff College course beginning in August and will become Senior Air Staff Officer to the Australian Air Attaché in Washington in January, 1959.

Royal Air Force Appointments

THE following are among recent Royal Air Force appointments:—

Group Captains: B. H. Boon, O.B.E., to H.Q., Maintenance Command, for air staff duties; W. S. Reed, to H.Q., Fighter Command, for technical staff duties.

Wing Commanders: S. J. Popham-Pursey, O.B.E., to Air Ministry, for duty in the Department of the Air Member for Supply and Organization (with acting rank of Gp. Capt.); R. I. Alexander, D.F.C., to Air Ministry for duty in the Directorate of Work Study; R. T. Billett to R.A.F., St. Eval, for flying duties; T. S. Kitching, D.F.C., to M.o.S.; J. T. Lawrence, A.F.C., to the Aircraft Department, Royal Radar Establishment, M.o.S., Pershore; I. N. M. Macdonald, A.F.C., to Air Ministry for duty in the Department of the C.A.S.; J. N. Stacey, D.S.O., D.F.C., to the R.A.F. Staff College, Bracknell, for directing staff duties; K. W. J. Tarrant, D.F.C., to the Joint Tactical School, Malta, as Assistant Director.

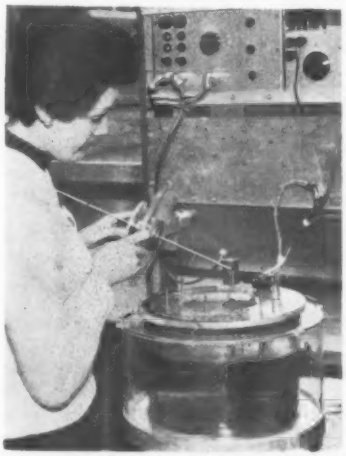
Squadron Leader V. W. A. Matthews to H.Q., Maintenance Command, for administrative staff duties (with acting rank of Wg. Cdr.).

Radar Research at Malvern

A "data extraction team" at work in the defence systems research section at R.R.E. Malvern.

A BRITISH defence against ballistic-missile attack was foreshadowed recently at the Royal Radar Establishment, Malvern, when a few selected R.R.E. activities were revealed. Development of a British anti-missile missile with a "clean" nuclear warhead was mentioned; it should be 90% operationally effective against ballistic-missile attack. Tests with such a missile are likely to be made in Australia within three years; it will be evaluated by attempted interceptions of the British IRBM under development by de Havilland Propellers.

The R.R.E. plays a leading rôle in the development of radar and missile systems for the Services. It conducts basic research, advises Service staffs on the application of research discoveries to operational problems and collaborates with manufacturers in the development of new equipment based on its researches. A description of some of the work and equipment at R.R.E. was given in THE AEROPLANE for October 4, 1957.



Production of crystals for molecular amplifiers. Here a seed crystal mounted on a shaft is being inserted into the appropriate solution in which it will grow.

Many of the Establishment's activities are connected with air-defence systems and missile research. Missile homing systems are studied and evaluated—an infra-red homing system was demonstrated. This forms part of a small research rocket with cruciform moving wings and tail surfaces. The homing head consists of a gyro-stabilized aerial which picks up heat energy from an aircraft's engine and focuses it via concave mirrors on to an indium-antimonide detector cell. The cell provides signals which keep the detector head focused on the target and also provides information to the autopilot which steers the missile towards it. The detector head appeared to sweep over a wide cone ahead of the missile; the included apex angle of this cone was about 80°.

Indium-antimonide cells of the type shown respond to less than one-hundred millionth of a watt of radiant energy. This is equivalent to detecting, at a range of one mile, the heat from a soldering iron at 300° C. If the cell is cooled by liquid oxygen its sensitivity can be increased by 10 to 100 times.

A demonstration film showed the efficiency of the detector head, which was focused upon a distant Canberra bomber. Despite violent evasive manœuvres by the bomber the detector head remained accurately fixed upon its target; as the detector was brought closer to the Canberra it concentrated upon one of the aircraft's two jetpipes.

The thorough development and study of infra-red homing at the R.R.E. suggests that this technique may be used for terminal homing of the anti-missile missile which was mentioned earlier. Computers, simulators and test vehicles are used by the establishment in missile-guidance research. R.R.E. guidance techniques are claimed to be as advanced as any in the World.

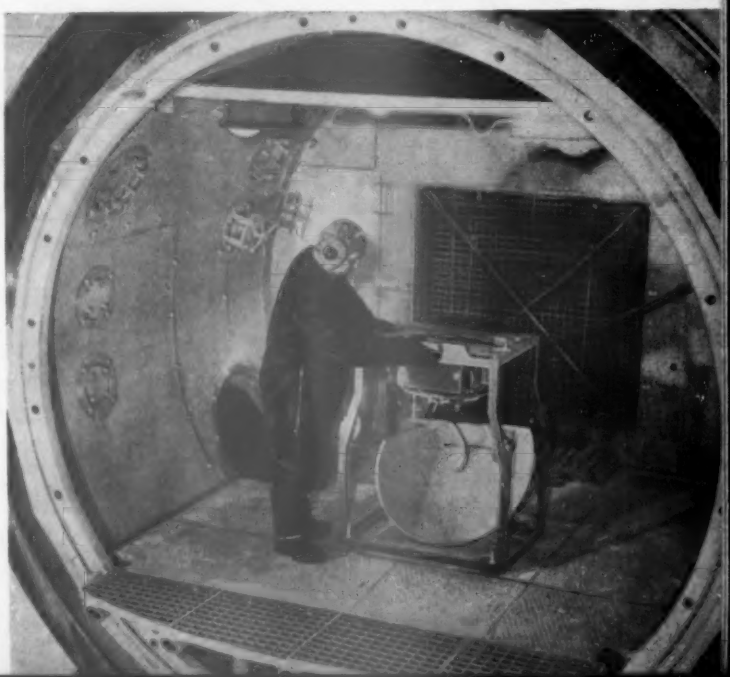
Much of the other work of the R.R.E. has applications either in missiles themselves or the radar equipment which goes with them to make up an integrated defence system. Computing techniques also play an important rôle.

Modern circuit techniques are studied and developed; the use of transistors enables equipment to be reduced in size and power requirement and its reliability increased. These techniques enabled one piece of data-transmission equipment to be reduced in physical volume by 99%; its power consumption was reduced by 3,000 : 1.

Defence System Development

At the R.R.E. a complete system for defence against aircraft has been developed; this system, it can be assumed, will in due course be extended to combat ballistic-missile attack.

The system depends on three types of radar. Early-warning



One of the larger pieces of equipment at Malvern is this stratosphere chamber capable of simulating conditions up to 100,000 ft. over a wide range of temperatures. Here, a radar scanner is being installed for test.

radar with the greatest possible detection range gives the first indication of an enemy attack; this information is fed to an operations room. As soon as the enemy aircraft approaches closer it is detected by tactical control radar sets which enable full details of height, range and bearing to be given to the operations room, where the complete battle situation can be studied and instruction given to precision radar sets which lock on to individual targets and control defensive missiles to these targets.

Because of the need for speed the entire defence system is semi-automatic; a system with an even greater degree of automation is likely for ballistic-missile interception.

In the system demonstrated at the R.R.E. the information given by tactical-control radars is plotted by R.A.F. operators and fed automatically into a computer which presents the position to the operational controller on synthetic radar displays. These show the position of aircraft, whether they are unidentified or hostile and the computer channel which contains data about them. Using this information the controller can press a button which automatically gives target information from the appropriate computer store to a precision radar. When this is locked on to its target a defensive missile can be fired.

Early-warning and tactical-control radars for a system of this type are being produced by Metropolitan-Vickers; equipment built by the company will be installed at the North Coates R.A.F. missile station. Precision weapon-control radar which keeps the target within a narrow pencil beam is being produced by British Thomson-Houston; its Sting-Ray equipment is to be used in conjunction with the Bloodhound and Thunderbird surface-to-air missiles which employ semi-active homing.

If, as may be assumed, this system is extended to counter ballistic-missile attack, the defensive weapon will probably be a development of the present-day ones or the anti-ICBM mentioned earlier. A missile of this type is likely to use more than one guidance system owing to the great range at which it must intercept its target.

A scientific development of the R.R.E. which also has military implications is the radio telescope. Besides receiving radio waves sent out by heavenly bodies, a radio telescope can be fitted with a radar transmitter and receiver which enables echoes to be received from bodies within the solar system.

The R.R.E. radio telescope is 45 ft. in diameter and can operate at wavelengths down to several centimetres. With it strong radar echoes were received from the first Russian Sputnik when it was nearly 1,000 miles away. Radar echoes have also been received from the Moon; using 5 millionth of a second pulses its distance can be measured to within 800 yd.

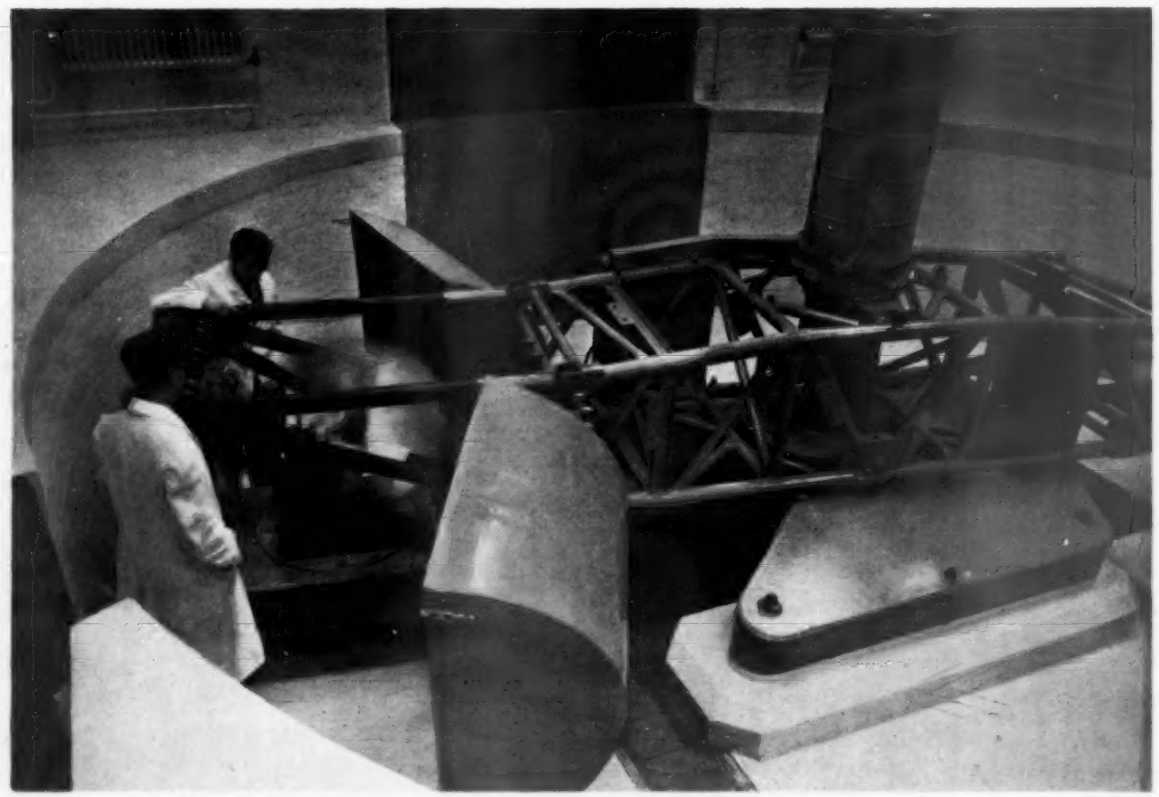
An R.R.E. development which will increase the sensitivity and thus the range of the radio telescope and other microwave receivers is the molecular or Maser amplifier. Maser is short for Microwave Amplification by Stimulated Emission of Radiation. Special crystals are used for this technique; their properties and production are under study at the R.R.E.

Navigation Systems

In 1950, a complete experimental Doppler-navigation system was flight tested at the R.R.E. The results were so encouraging that a contract was placed with Marconi's Wireless Telegraph Co., Ltd., for the development, in conjunction with the R.R.E., of a Doppler system for the Royal Air Force. This equipment has now been in Service use for four years. It weighs 244 lb., operates between 250 ft. and 60,000 ft. and now has a 95% reliability rate in service.

A second version was developed for use in both the Royal Navy and R.A.F. It is smaller and lighter, since there are stricter limitations on the space available for installation. Marconi are now in production with this equipment, which weighs only 190 lb.

A third version is now being developed which wherever possible uses transistors to cut down the weight and improve reliability. It will weigh less than 100 lb., and have a power requirement of only 200 W. A civil version of this equipment will weigh 60-70 lb. and is likely to be available for airline evaluation within six months.



An important part of the research associated with radar equipment generally is the determination of the effects on the components of high g loads. This centrifuge can develop up to 40g at the test cage.

Hunter History

WITH the Hunter order book showing such an encouragingly large commitment at the present time, it is hardly surprising to learn that next year the Hawker factory at Kingston-on-Thames is likely to reach the highest production rate for Hunters so far attained. Among the more recent contracts received for this eminently exportable and extremely versatile fighter, has been that from the Swiss Government last year for 100 Avon-powered Hunter Mk. 6s.

It is perhaps a measure of the soundness of the Hunter's lineage that this order was obtained in the face of heavy competition, for the Swiss Air Force considered about half a dozen different types that appeared to meet their requirement for a ground-attack aircraft to replace their Venoms. The choice was eventually reduced to either the Hunter or the Canadair-built Sabre. And after an extensive and searching trials programme in Switzerland, the Hawker Hunter was eventually selected.

As a direct result of these Swiss trials, an Indian delegation visiting this country last year decided to place a £26m. order for 160 Hunters and spares for the Indian Air Force.

The two-seater trainer version of the Hunter (see THE AEROPLANE for January 3) which forms the subject of the cutaway drawing on the next two pages has also proved a very good export. In addition to being in production for the R.A.F. and the R.N., two-seaters have been ordered by India, Denmark and Holland.

It is not permissible to reveal the total number of Hunters of various sorts that are on the production programme at Hawkers for the next year or so. Nor can the hoped-for rate of production be given. Nevertheless, it seems axiomatic that any fighter from Sir Sydney Camm's design team would be in demand by a number of the World's air forces and equally that the Hawker production engineers would see that the orders were fulfilled in more than double-quick time.

However, be that as it may, our purpose here is to give some brief chronological background to the Hunter. It can in fact trace its birth back to the P1040—Hawker's first jet aircraft—intended for research and having a Rolls-Royce Nene using the company's patented bifurcated jet pipe, with the efflux emerging at each side of the fuselage. The prototype first flew on September 3, 1947.

Interest in the P1040 was most evidenced by the Royal Navy who subsequently wrote their N7/46 specification around it. From this came the Sea Hawk, the prototype of which flew on August 13, 1948. The Sea Hawk Mk. 1 was put into production at Kingston and 35 were built there before remaining production and development work on this aircraft was handed over to Armstrong Whitworth.

By this time it had become obvious that a swept-wing version of the P1040 would eventually be needed as a high-speed type. Another prototype was therefore built and given a 10% wing with a 35° sweep. This aircraft was the P1052 and it flew on November 19, 1948. (A second aircraft flew in April the following year.)

With a Rolls-Royce Nene, the P1052 had a maximum sea-level speed which compared very favourably with the Meteors then flying. It was, however, only a research aircraft and had no armament.

While flight tests were in progress with the P1052, Hawkers fitted an Armstrong Siddeley Snarler liquid propellent rocket-engine in the tail of a P1040. This "mixed powerplant" aircraft was designated the P1072 and had a much improved performance under climb conditions. To allow for the rocket propellents it carried a reduced amount of turbojet fuel. The P1072 had the straight wing of the P1040 but it was thinned to 9½%.

The final step in the pre-Hunter development was the P1081. This was the second prototype of the P1052 modified to have a straight-through tailpipe in place of the earlier bifurcated version. It was, in fact, a rudimentary Hunter with a swept tailplane and fin and the prototype, powered by a Nene 2, first flew on June 19, 1950. Almost immediately afterwards it made a record-breaking run from London to Brussels; its time for the trip was 20 min.

During this period of development with the P1052 and P1081, the Hawker team had been examining as a longer-term project, and as a production-type, a fighter configuration designated P1067. This was intended to fulfil the Air Ministry's F3/48 specification for a transonic fighter mounting 30-mm. Aden guns as its armament. It had a 40° swept wing with an 0.085 thickness chord ratio.

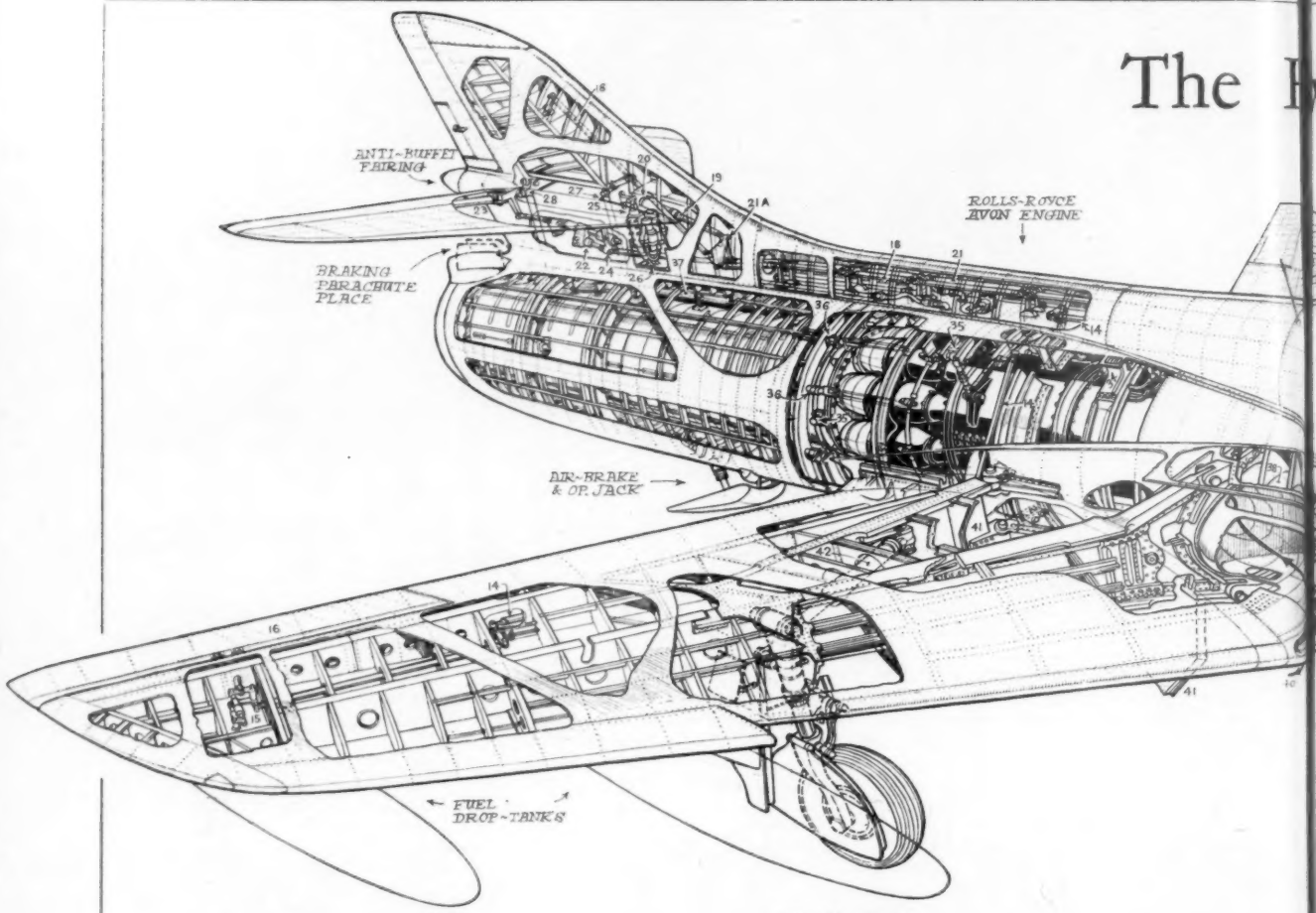
The first prototype of this aircraft made its maiden flight on July 20, 1951. Three prototypes were in fact built—the first was unarmed and the second had four Aden guns; both these aircraft were powered by Rolls-Royce Avon turbojets. The third prototype was powered by an Armstrong Siddeley Sapphire.

There were two major set-backs to the initial production of this aeroplane. Both of these are well known and need no detail repetition here. First there was the need to install an airbrake and secondly the Avon engines tended to experience a flame-out when the guns were fired. Both these troubles were eventually overcome and the Hunter, as the aircraft had become known, settled down to steady production as the Royal Air Force's new fighter.

The first production aircraft made its first flight on May 16, 1953. Armed with four Aden guns, it was the most heavily armed aeroplane to go into squadron service anywhere in the World.

Simultaneously with the Hunter 1, the Sapphire-powered Hunter Mk. 2 went into production at Armstrong Whitworth. The prototype had flown for the first time on November 13,

The Hawke



KEY

1. Nosewheel well.
2. Nosewheel door and operating jack.
3. Limits of pressure-cockpit.
4. Cockpit pressure-control valve and outlet (with bleeds for radar cooling).
5. Four-branch air supply to cockpit from engine-compressor bleed for anti-misting (6), pressurizing and heating via water-separator (7) and regulator valves (8).
9. Ram air to cockpit.
10. Air extractor.
11. Ejector seat gun.
12. Dual throttles.
13. Aileron control from control columns (13), rods (14) hydraulic servo-jack (15) to aileron (16).
17. Rudder control from rudder bars (17) and rods (18).
22. Elevator control from control columns (13), rods (21), se jack (22) and elevator shafts (23) with spring-feel unit anchored at (20) and connected to rods (21) at bell-cr fulcrum (21A).

1952, and the first production version on October 14, 1953. This aircraft was marginally faster than the Hunter 1 and was externally identical. Only a small number of Mk. 2 Hunters was built, however, and these went into service with three R.A.F. squadrons.

The Hunter 3, of which only one was built, was the first Hunter prototype modified to have the Rolls-Royce Avon RA7R with re-heat. It flew for the first time on July 1, 1953, and on September 7, 1953, captured the World's air speed record at 727.6 m.p.h. As a matter of interest, this particular airframe had been the one on which the airbrake development had been done and the record-breaker, in fact, had fuselage-side airbrakes.

The Hunter 4—still basically a P1067—was the first of these aircraft to carry ground-attack equipment. Initially it had two underwing pylons to carry 1,000-lb. bombs or 100-gal. drop tanks. Later, two more pylons were added outboard of the original ones and these enabled four drop-tanks or a "mixed" load of drop tanks and bombs to be carried. As an alternative to the pylon load the Hunter 4 could carry 24 3-in. R.P.s.

This aircraft was the first ground-attack tactical fighter to be produced and it went straight into service with 2nd T.A.F. No prototype as such was built; the first production aircraft flew on October 20, 1954. Production was at Kingston and Blackpool.

It was decided that the Hunter 4 could be offered to overseas customers and as a result a very healthy export of these aircraft was started. Sweden was the first customer with an order for more than 100 (Mk. 50s) and four days later Denmark bought some (Mk. 51s). Still later several Hunter 4s were exported to Peru; these were ex-R.A.F. machines and were known as the Mk. 52.

Hunter 4s were also built under licence in Holland and Belgium for N.A.T.O. air forces. A fighter reconnaissance version, the F.R.Mk. 4 was developed to an R.A.F. specification, but this was not proceeded with.

Next on the Hunter list is the Hunter 5, a Sapphire-powered successor to the Hunter 2, to which it bore the same relationship as did the Mk. 4 to the Mk. 1. This aircraft had the Sapphire 101 and about 150 were built, all for the R.A.F. A more powerful version with the Sapphire 7 was projected as a private venture but it was not proceeded with.

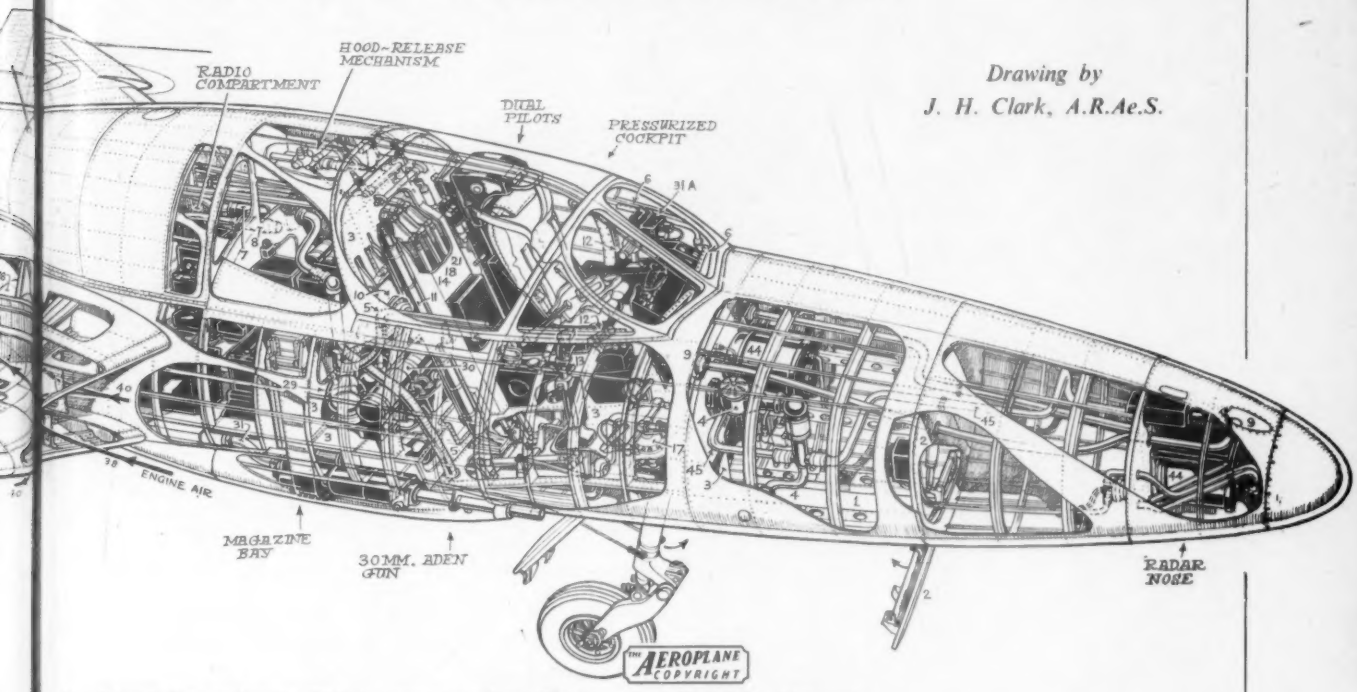
In about 1951-52 the Hawker design team decided to produce a version of the Hunter capable of supersonic speed in level flight. This was the P1083 which was to have either a Sapphire or an Avon and steps were taken to build a prototype.

It had a 6% wing swept to 50° and was given increased sweep on the tailplane and fin. The aircraft was expected to be a participant at the 1953 S.B.A.C. Display and was almost complete when in July of that year the Ministerial axe fell on it in favour of Supermarine 545—which itself was shortly afterwards axed.

Thus, the opportunity was lost to give the R.A.F. a supersonic

Hawker Hunter T.Mk.7

7,500 lb. s.t. Rolls-Royce Avon Turbojet



Drawing by J. H. Clark, A.R.Ae.S.

24. Servo-jack is anchored at (24) for servo operation. For direct manual control from control column to elevator the anchorage (24) is released and jack (22) made to act as a solid part of control-rods (21) (same principles for aileron control).
25. Tailplane variable-incidence actuator (25) anchored at (26) operates on to tailplane front spar at (27).
28. Tailplane hinge-point.
29. (In cockpit) four emergency-air bottles for undercarriage and flap operation and anti-*g* system air.
30. Inverters.
31. Air cooling to cannon.
31A. Port gun-sight.
32 and 33. Not used.
34. Engine bearing-cooling duct (each side).
35. Engine mountings.
36. Fuselage joint with interconnections between stringers.
37. Jet pipe transport rail.
38. Wing root engine air intake.
39. Contour lines to indicate duct profile.
40. Boundary-layer air bleed.
41. Undercarriage wheel-well and door.
42. Undercarriage combined operating jack and side stay.
43. Not used.
44. Radar in nose with cooling-air pipes (45).

fighter which could have flown six months before the Hunter 6 and could by now have been established in Squadron service. And, quite apart from that, if it had been allowed to proceed it would, no doubt, also have been a very valuable export commodity.

Although based on the Hunter, the P1083 had what was virtually a new airframe design. It incorporated some advanced thinking and embodied all the experience and lessons learned with the earlier Hunters.

Next on the list is the P1099 or Hunter Mk. 6, the current standard version in service with the R.A.F. For this, the layout went back to a conventional Hunter wing with a 0.085 t/c and a 40° sweep. It was powered by an Avon 200 Series turbojet and the prototype first flew in January, 1954; the first production Hunter 6 flew in March, 1955.

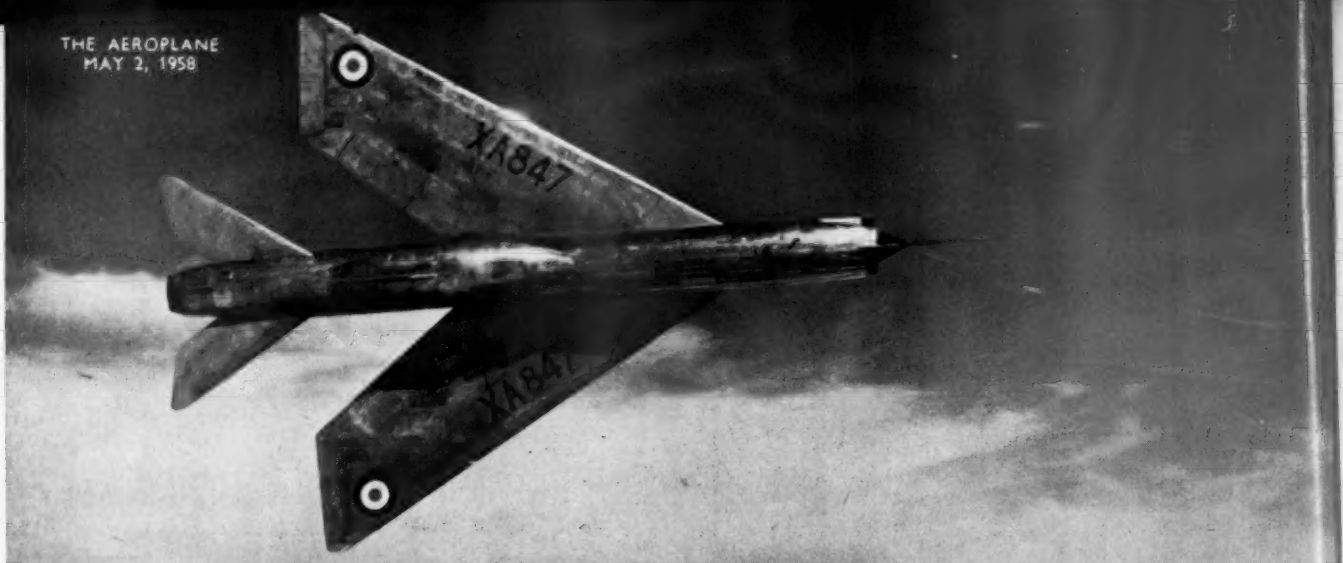
To begin with the only external difference from its predecessor was a slightly larger tailpipe diameter. The initial wing for the aircraft had a straight leading-edge and an area of 340 sq. ft. Later flight tests, however, established that the higher performance of this version of the Hunter had accentuated the pitch-up problem and as a result the wing was subsequently modified to have a saw-tooth leading-edge—with a resultant small increase in area to 349 sq. ft.

Four wing pylons and four strong points for external stores are provided on the Hunter 6 and, because of the greater power of the Series 200 Avon, larger external fuel tanks can be carried. These now hold 230 gal. each and the aircraft can in fact carry two of these and two of the smaller 100-gal. units. And with this fuel load a Hunter 6 was flown on a range check to Northern Italy last year.

The background story of the two-seat Hunter Trainer, or T.Mk.7, has already been given in our pages (January 3). The prototype based on a Mk. 4 airframe first flew in July, 1955—and a second prototype, based on a Mk. 6 airframe, made its first flight in the autumn of 1956. As we have already said, this Hunter variant is in production for the R.A.F. and for a number of other air forces.

Most recent of the Hunters to go into production is the Hunter 8 two-seater intended for the Royal Navy. This is a Mk. 4-based aeroplane equipped with an airfield-type arrester hook and Naval radio equipment.

Finally, to complete this brief history of Hunter development, mention must be made of one or two "special" versions for research and development. Typical of these was a Mk. 1 with an Area Rule fuselage and another Mk. 1 with blown flaps. About four years ago a Mk. 2 Hunter was flown with four Firestreak missile mock-ups and later a Mk. 4 was equipped with two Fireflash missiles. And also among the missile-carrying Hunters there is the P1109 with an extended nose to take the radar associated with Firestreak—an example of which, carrying two of these weapons, was displayed at Farnborough last year.

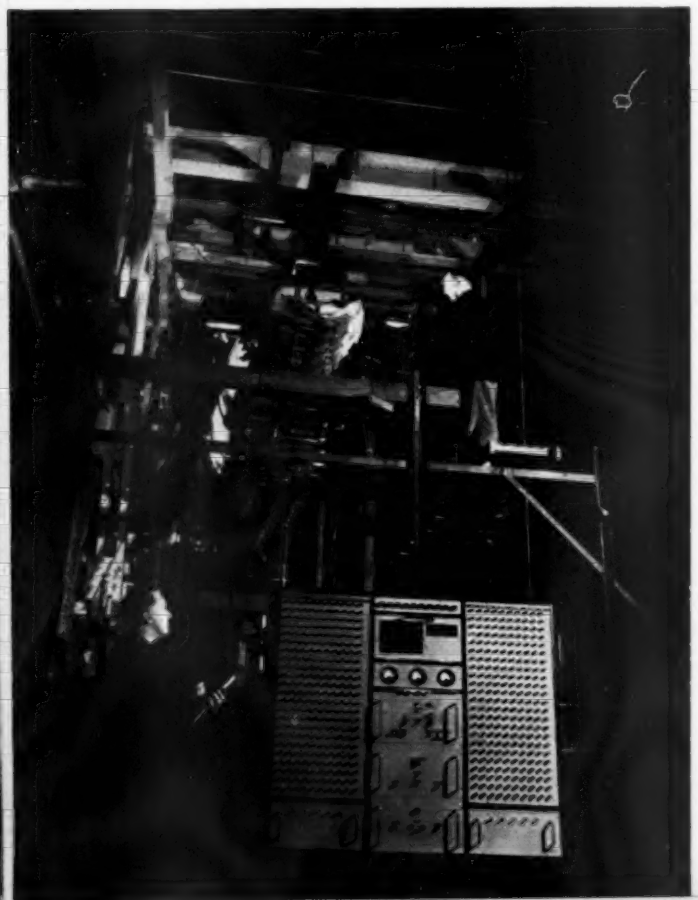


Development Testing of the English Electric P.1

Photograph copyright "The Aeroplane"

POSSIBLY the last fighter to be produced in Britain, the English Electric P.1B is a formidable aircraft. It has come a very long way since its original conception as a research aircraft. Even at the initial design stage provision was made for the aircraft to carry a military load, and this foresight was rewarded in 1953 when a fighter specification in line with P.1 performance was issued.

The first of the two P.1As flew in August, 1954. The P.1A was not a truly military aircraft, however, although it enabled the basic configuration of the P.1 to be proved in flight development.



To meet fighter requirements the fuselage of the P.1 was completely redesigned with a centre-body intake, and full allowance was made for the installation of weapons, search radar and other military equipment. Rolls-Royce Avon engines with afterburners were installed, greatly increasing the thrust available. Only detail changes in the wings and tail unit were necessary.

The resulting aircraft, the P.1B, first flew as a prototype in April, 1957. Twenty pre-production P.1Bs were ordered to speed development and since then a production order has been placed for the aircraft.

Officially it has been said that no manned fighter will follow the P.1. As the last fighter it bears a heavy responsibility and is likely to be developed extensively. Although a single-seater, it is a very expensive supersonic all-weather fighter.

Development of the P.1 as a mixed powerplant fighter was announced recently. A Napier Double-Scorpion rocket motor in a ventral pack can be attached to the aircraft to increase its rate of climb and operational ability at very high altitude.

Versatility in armament is likely for such an important aircraft as the P.1. Firing trials with the 30-mm. Aden cannon have been shown in photographs. P.1Bs will also operate with Firestreak infra-red homing air-to-air missiles.

In the development of the P.1 English Electric has been working far beyond the limits of past aircraft experience. P.1 operation at very high speeds and altitudes brought many new problems to be solved by the company. The P.1's speed, for example, is such that the aircraft approaches the "thermal thicket" where kinetic heating involves structural and cooling problems.

The functional and structural testing which has been done during the development of the P.1 is described here. This work is of particular interest as the P.1 is, perhaps, Britain's fastest aircraft, and many of the testing techniques which have been pioneered by English Electric will be used more widely in future, particularly in the development of supersonic airliners.

The exact range of temperature over which P.1 systems, fuel tanks, canopies and radomes have been tested cannot be revealed, but broad limits can be guessed on the basis of published P.1 performance. So far as low temperatures are concerned it is known that the P.1 will operate in the stratosphere, where the temperature is −56.5° C. The upper limit is indicated by the fact that the P.1 has flown faster than the 1,132 m.p.h. of the record-breaking Fairey F.D.2. At this speed the stagnation temperature rise is 128° C.

Strength of the P.1 ventral fuel tank was checked by loading it in the fashion shown.

The general background to the structural and functional testing of the P.1 follows the pattern usual for all advanced new aircraft. Initial work was done on structural panels and a wing box to provide design information. Rigs were built to simulate operation of the aircraft's control, hydraulic, compressed-air, electrical and pressurization systems. Static testing of castings and other structural elements was undertaken; as development continued, progressively larger sections of the airframe were tested until, finally, structural tests were made on a complete aircraft.

The interesting feature of P.1 development lies in the pioneering work that was done on proving aircraft systems over temperature ranges and in the thoroughness with which structural and functional testing has been carried out.

It is impossible for testing to be described in a chronological order as so much is done simultaneously. In this account functional tests are described first and structural testing afterwards. This order is chosen only because the initial functional trials precede the first flight of an aircraft, and structural testing of a complete airframe usually, although not ideally, comes later.

Power-control Rig

The P.1 was one of the first aircraft to have fully duplicated irreversible power controls. Artificial feel is provided by springs for the ailerons; for the rudder and elevator there is dynamic-pressure feel with spring stand-by.

Much development was needed both of the power-control units themselves and of the system as a whole. A fully representative rig was built which simulates all the controls and control runs. Each control surface on the rig has the correct stiffness, inertia and aerodynamic loading. All rig components can be supplied with hot or cold air to simulate temperatures experienced in flight.

Much development work has been done with this rig. The power-control units were designed by H. M. Hobson, Ltd., to English Electric requirements. Initially, high valve forces were involved; these were reduced so that auto-stabilization units could work effectively. Impulse pressures were measured to give the flying-control jack manufacturer the information needed for fatigue tests on the jacks.

Life tests have been carried out on the power-control rig, the aim being to achieve a 1,000-hr. life with a factor of 6¾. In other words, the system has to show a satisfactory life on test of 6,750 hr.

The life of the system has gradually been built up on the rig by operating it over a series of duty cycles, with representative control movements made by a series of cams. System components were subjected to the range of temperature met in flight.

Control-jack life has been gradually increased in this way by stripping the units periodically and clearing them for additional flight cycles if they were in a satisfactory condition. The system has been developed so that its life is always well ahead of the flying hours of the prototype aircraft.

Although temperature effects can be partly simulated by reducing the viscosity of the oil in the system, English Electric did not choose this approach. Their method of using hot or cold air enables actual flight temperatures to be reached, and thus heating effects on jacks and seals are accurately represented.

A great deal of development work has been done by English Electric on the P.1 power controls. At first it was necessary to reduce friction in the circuit and to produce a system giving control-feel acceptable to pilots. New and accurate instrumentation had to be developed and problems such as sealing the pressure cabin where control rods passed into it had to be solved.

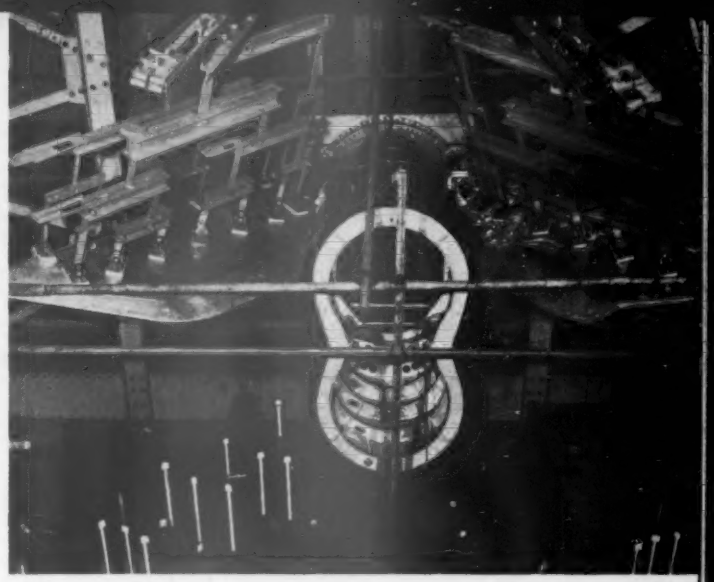
As the P.1 developed, the flying-control rig was modified to keep it up to date and to prove any modifications made to the system.

Hydraulic-system Rig

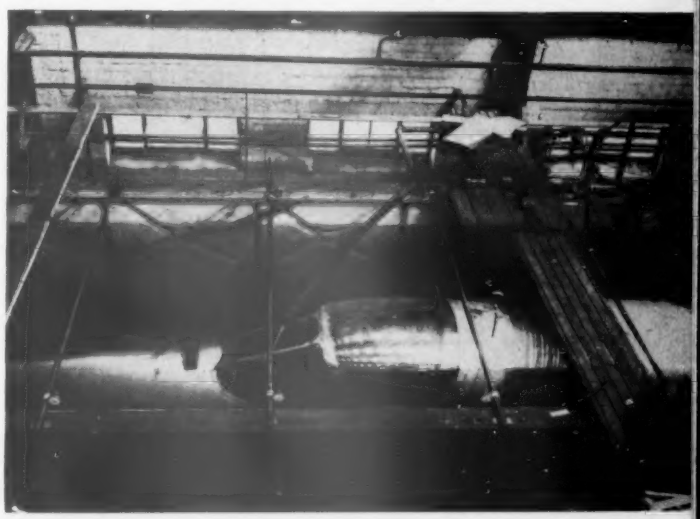
A rig was built to represent the complete hydraulic system; it has all the piping runs on the aircraft and all the British Messier components, suitably loaded. Undercarriage, flaps, air brakes, wheel brakes and the power-control feel-system are represented; hydraulic power is provided by two pumps driven by a Diesel engine. On the aircraft these pumps are driven by the P.1's Avon engines.

This rig was used to prove the functioning of the P.1 hydraulics at high and low temperatures, and for endurance testing of the system. Components are boxed in and supplied with air at the required temperature. The aim was to achieve a 1,000-hr. life for the system with a factor of six.

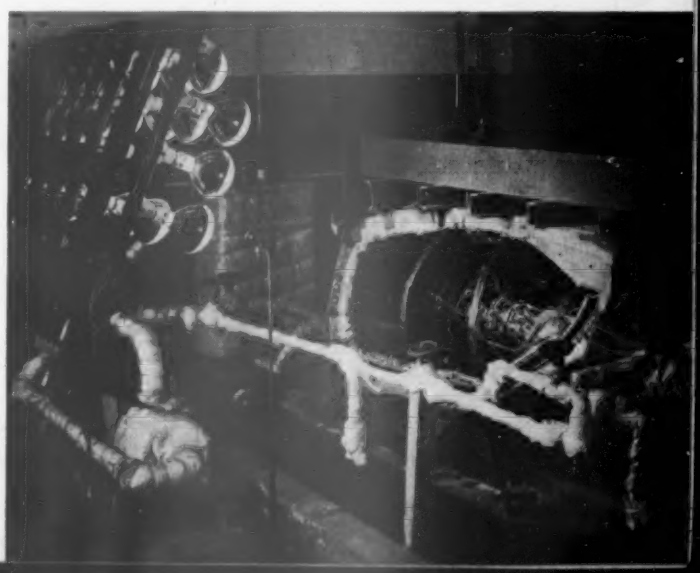
A feature of hydraulic testing, and for that matter other system testing, was that much officially type-tested equipment had to be examined to ensure that it met P.1 requirements. Components proved for contemporary aircraft often failed to work satisfactorily over the range of P.1 operating temperatures. This increased the development work greatly as many system



Above, in this structural test P.1 tailplane loads were applied to simulate the critical design case. Below, strength of the P.1 cockpit and canopy under pressurization loads was checked by water-tank tests.



Below, a bank of heaters simulated aerodynamic heating effects on the P.1 cockpit canopy, which was pressurized during this test.



components themselves had to be thoroughly tested—apart from evaluation of each system as a whole.

Impulse loads were measured on the hydraulic rig; this information enabled British Messier, Ltd., to make fatigue tests on the jacks.

Development work on the rig has led to a decrease in undercarriage retraction times. Another point studied was the unlocking of P.1B airbrakes, which had occurred unexpectedly during flight tests. This was not dangerous as the airbrakes open against the airflow, but its cause demanded study. It was found that when the airbrakes were shut there was a closed hydraulic loop which included the airbrake locks. Because of heating, the hydraulic fluid expanded and released the airbrakes. The system was modified to prevent this happening.

Hot-air and Fuel-system Rigs

On the P.1 hot high-pressure air tapped from the engines is used for a variety of purposes. Cabin pressurization and air conditioning, anti-icing, demisting, electrical power generation via an air turbine—these services are provided by hot air, and cooler air is used for many other duties, such as gun purging, equipment cooling and fuel transfer.

A rig simulates all the valves and pipe runs of the hot-air system. Dealing with air at high temperature and pressure is no easy task. Lubrication difficulties with valves have had to be solved and much work has been necessary on the life testing of air pipes and their flexible couplings. The escape of air at high temperature and pressure could have fatal effects on the fuselage structure.

Air conditioning and pressurization tests on the P.1 have been carried out by Sir George Godfrey and Partners, Ltd., and de Havilland Propellers, Ltd. English Electric, however, has developed a unit for cooling air tapped from the engine to 100° C. It is a heat exchanger in which the air is cooled by vaporizing water which is carried in a storage tank. The steam is vented overboard; enough water is carried for one sortie. After leaving this heat exchanger the cabin air passes through a de Havilland cold-air unit and then to the cockpit via a pressure-control unit.

There has been extensive development of the P.1's fuel system and integral tanks; each possible leakage path for fuel is doubly sealed.

Integral wing tanks have been developed in three stages. Initially, small details, such as riveted lap joints, were tested by subjecting them to several thousand cycles of shear loading. The inner surface of the joint was built into a tank filled with kerosene under pressure; the aim of the test was to ensure that there was no fuel leakage through the joints. In tests of this sort a special leakproof riveting technique was evolved. Each rivet hole has a sharp-edged ring projecting from its countersinking; when the rivet is closed this ring cuts into the rivet and makes a leakproof seal.

After basic sealing techniques had been proved in this way critical sections of the actual wing tank were tested by building them into a box. This was filled with fuel under pressure and subjected to many cycles of a racking load to prove the sealing techniques used.

Final sealing tests were made on an actual P.1, the tanks of which were filled with fuel under pressure. The wing was subjected to loads ranging from −10% to +40% of the ultimate and temperature effects were simulated at the same time. For low temperatures the surface was covered with carbon-dioxide dry ice; electric blankets were used for heating it.

These tests ensured that the tanks would not leak; others proved the functioning of the system. A rig was built to check fuel flow during aerobatic manœuvres; a tank could be rolled and pitched and all appropriate accelerations applied except those normal to the airframe. The quantity of unusable fuel for various attitudes was determined and the best positions for fuel-contents gauges were found.

The effectiveness of the system at different temperatures was measured and valves were developed which would work well over the heat range of P.1 operations. As with other systems, type-tested components had to be re-tested and often modified to suit the needs of the P.1.

Testing the Electrics

A representative rig of the electrical system was built on which the aircraft's English Electric AC and DC generators were driven by Diesel engines. The complete distribution system was represented with the actual electrical looms used on the aircraft. This enabled the interaction of current passing through different cables to be studied.

As with all other systems, the P.1 electrics were tested over a range of temperatures. In addition, components were subjected to air at varying humidities; electrics tend to be temperamental under the low humidity of high-altitude operation.

The P.1's guided-missile and 30-mm. Aden cannon armament systems have also been subjected to extensive testing. Cannon installation and firing problems have been studied at firing ranges and any necessary modifications were made before the system was cleared for air firing. Link-collection, gun-purging and blast-deflection systems have been thoroughly checked and modified and improved where necessary.

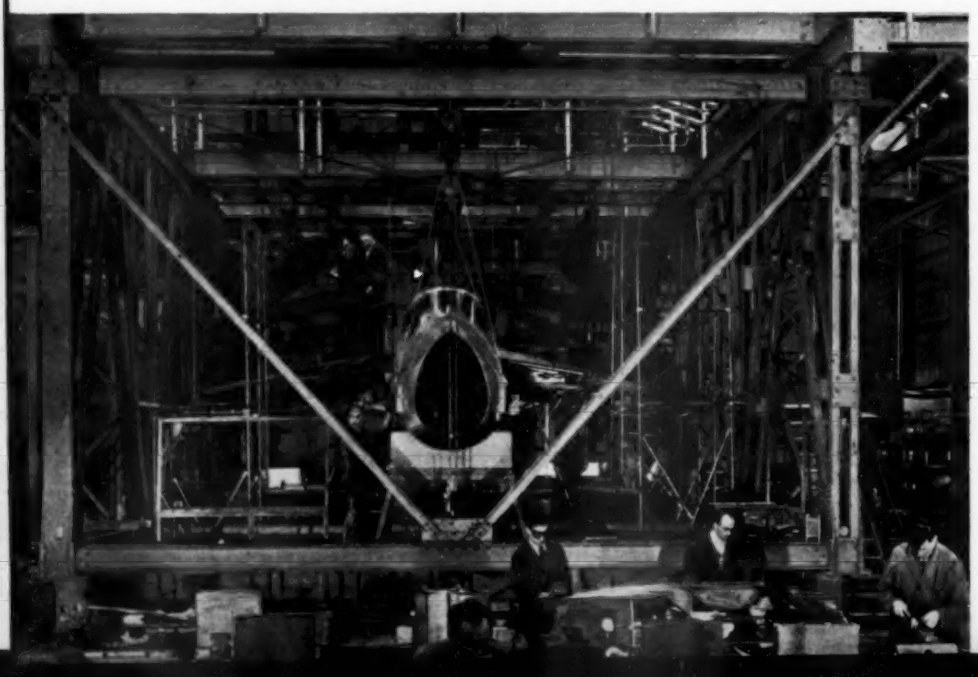
Mechanical-system and Structural Tests

Apart from the major systems, a series of mechanical systems for the P.1 have been developed and their operation endurance-tested over a range of temperatures. They include the brake-parachute release and jettison mechanism, and the canopy-jettison system. Final proving of canopy-jettison systems was done at Boscombe Down with a blower tunnel.

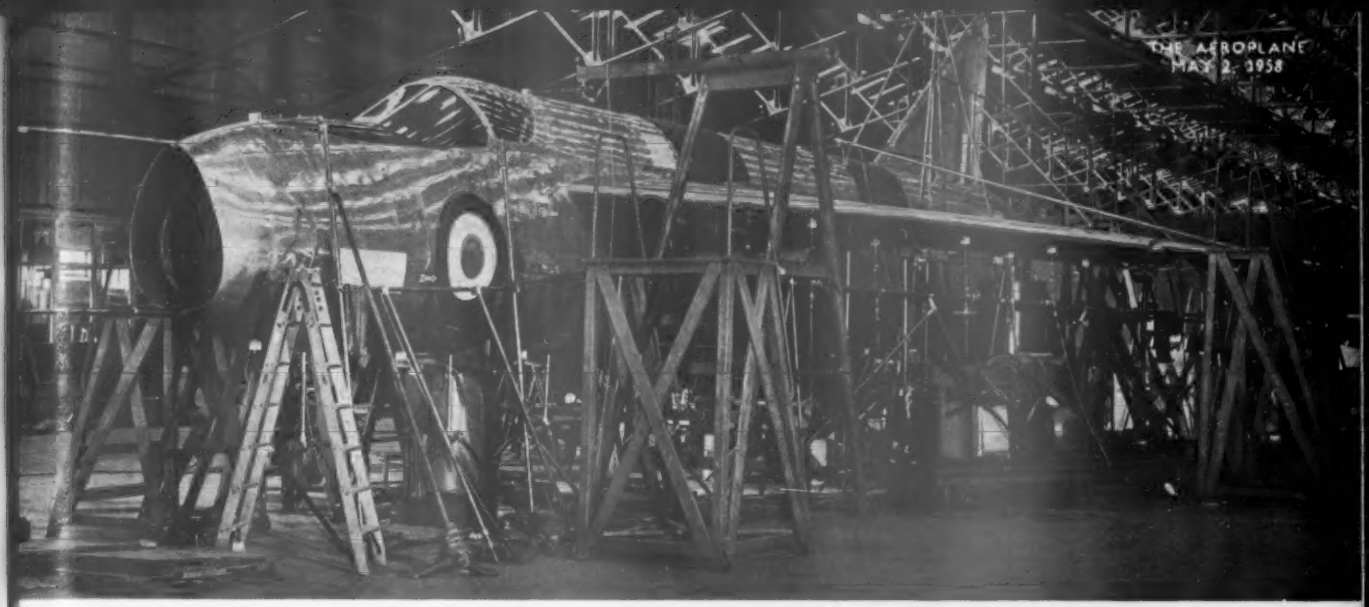
In some cases mechanical and structural problems are combined. A typical case on the P.1 was the bearing and housing for the slab tailplane. A small and highly loaded component, the bearing presented a difficult development problem. Fatigue tests on it were made at high temperatures.

One of the most interesting tests on the P.1 structure was that to discover the effect of engine ground-running on the air-intake duct. It was essential that no rivets or parts of the duct should break away and enter the engines.

A test nose-fuselage was set up with two Sapphire engines in the appropriate positions. Running of the engines led to duct cracking, and appropriate modifications were made. As a result of these tests, intake doors were fitted which opened during ground-running only; their effect was to reduce the



The strength of the P.1 fuselage and wing was checked by applying loads to them in this large test frame.



Resonance tests on the P.1A were carried out by vibrating its structure over a wide range of frequencies.

pressure load on the ducting. No ground-running problems have been experienced on actual P.1 aircraft.

Fatigue tests were made on the ducts; in this case positive internal pressure was applied to give the effect of ram-air pressure during flight.

Structural tests have been made on individual components, such as the fin, the tailplane and the section of rear fuselage on which it is mounted, the undercarriage doors, the glass-cloth tailplane tip and the metal honeycomb-sandwich tips of the ailerons and rudder.

Development work has been done on wing joints, which have been fatigue-tested, on hatch connections and on the main engine hatches.

So far as the major structure is concerned, a complete test has already been made on a P.1 and a similar one on the P.1B will follow soon.

Only slight modifications were necessary following the test on the P.1A, which was very successful. The wing failed at 101% of the ultimate design load.

Tests were made for two design cases. The first simulated a fishtail manœuvre (one in which a yawing oscillation builds up). This is the critical manœuvre for the fin and rear fuselage. Following successful completion of this test the airframe was loaded to destruction to represent the high-*g* design case.

Tests were also made on a wing to represent the rolling pull-out case. Aileron loads were applied in this test, which is the critical one for the outboard wing. In this work the airframe structure was thoroughly strain-gauged and loads were applied through hydraulic jacks.

The tests to be done on the P.1B airframe will be similar, but in this case drag and thrust loads will also be applied. The thrust loads, for example, will be partly reacted on the air-brakes. Through development, the all-up weight and thrust of the aircraft have increased and the test loadings will necessarily be higher.

During these tests on major structure, heating has not been applied as its effect would be negligible. In most other structural tests, however, temperature effects have been simulated. The materials used for radomes and canopies have mechanical properties which vary markedly with heating and the effect of high temperatures must be studied.

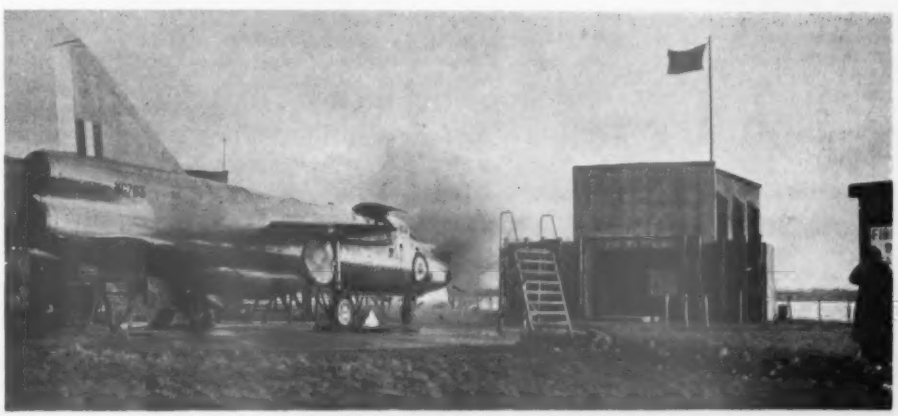
Thorough tests have been made on, for example, the cockpit canopy. Initially it was exposed to many low-temperature cycles to check that differential expansion did not affect the edge attachments. Then an endurance test was made, with internal pressure and heat cycles applied. The final test was one to check that it would withstand a pressure many times greater than the working one before it failed. Similar tests have been made on the windscreen panels.

A proving technique of this sort has been used for radomes, and special attention has been paid to the radome of the air-intake bullet. If this were to fail the result on the engines would be catastrophic. This radome bullet has been strength- and fatigue-tested at high temperatures, with the loads applied representing aerodynamic suction and internal pressure.

A thorough series of tests is being made on the P.1B ventral fuel tank. This tank is identical in external shape with the Double-Scorpion rocket-motor pack which can take its place on the aircraft and converts the P.1B into a mixed-powerplant fighter.

Extensive development has been needed for this pack, the front of which forms an integral tank for the high-test peroxide oxidant of the rocket motor. English Electric has issued its own specification for the aluminium-magnesium alloy for this tank. The final manufacturing treatment decides whether or not the alloy will be compatible with high-test peroxide and, therefore, suitable for holding this oxidant.

The evolution of the P.1 probably represents as great an effort as any facing a British aircraft company. This survey has covered only one narrow and limited aspect of work on this aircraft, but in this field alone so many new techniques have been evolved and new difficulties overcome that the immensity of developing it as a whole can be appreciated. Clearly the development of the P.1, a fighter without peer in Britain, has been, is and will be for some time to come an immense task indeed.—J.R.C.



At the gun butts the 30-mm. Aden cannon of the P.1 were fired to check link-collection, purging and blast-deflection systems.

Target for Tomorrow

This recent S.A.E. paper on the "Design Problems of Very High Speed Flight" by KERMIT E. VAN EVERY, M.E.(Ae.), A.F.I.Ae.S., *chief aerodynamicist, Douglas El Segundo Division, discusses the design problems of manned hypersonic flight. The proposed Douglas D-558-III rocket-powered research aircraft was designed for a speed of Mach* 9 (6,000 *m.p.h.*) *and an altitude of* 750,000 *ft.* (140 *miles*).

THE IMPORTANCE of manned aircraft versus missiles has been, and will continue to be, debated, but there are many reasons why it is advantageous to continue the development of manned aircraft. A number of these reasons have been pointed out by Crossfield and Flickinger in recent talks and papers (Refs. 1 and 2). Among the outstanding points which they make are the following: (1) A pilot is a necessary complement to the control system unless all circumstances occurring during the flight can be computed with mathematical certainty. (2) A human pilot is the lightest, most versatile computer available for control where response times in excess of a second are adequate. (3) A manned vehicle can serve as its own transport, thereby simplifying the logistics problem.

Additional emphasis to the development of manned vehicles has been given by the successful launching of satellites Sputnik 1 and 2, and Vanguard Explorers since it has made people realize that the day of space travel is something imminent rather than something in the far distant future. Aside from the obvious military and scientific advantages of manned satellites and spaceships, man's innate curiosity will compel him to go along on future trips whether they are just faster and higher than present aircraft, or to the moon or outer space.

The development of very high speed aircraft is, of course, a logical progression from present-day military aircraft and more specifically from previous high-speed research aircraft such as the Douglas D-558-I and -II, and the Bell X-1 and X-2. Several years ago the importance of a further investigation of altitude and speed by the use of advanced research aircraft was independently realized by the U.S.A.F., the U.S.N., and the N.A.C.A., and numerous research and design studies were undertaken by these government agencies in conjunction with certain aircraft firms. These studies were finally co-ordinated in a joint effort which emerged as the North American Aviation Company's project, the X-15, now under construction (see THE AEROPLANE, January 17, 1958, p. 66).

As part of the U.S. Navy programme prior to the joint project, the Douglas Co. prepared a study of a high-altitude, high-speed research aircraft starting in June, 1953, which was visualized as a first step in getting man out into space in order to explore the problems that would occur both to the aircraft and to the man. For the sake of identification, this study was designated D-558-III (in continuation of the D-558-II Skyrocket), and the aerodynamic configuration is shown in Fig. 1. (As discussed later, under Stability and Control, some modifications to the tail configuration were found to be necessary.) The present paper draws on the results of this study to illustrate some of the specific problem areas that occur on any high-speed, high-altitude vehicle.

Flight Spectrum

For orientation purposes, Fig. 2 illustrates what might be termed the entire flight spectrum in terms of altitude v. speed, with the significant performance of various manned vehicles, such as balloons and previous research aircraft, indicated along with that of present or contemplated satellites. For convenience in talking about satellites and space vehicles, the speed scale is in ft./sec., but for expediency in referring to conventional aircraft types an m.p.h. scale is also inserted. Altitude is expressed in statute miles. This chart shows the progress of manned flight to date, the operating regime of satellites, the initial region for space travel, and the very large region of speed and altitude in-between where there has been no manned flight as yet.

Although the large empty areas on this chart might give the impression that it is possible to progress from our currently available aircraft to the operating regions of manned satellites or space vehicles along many routes, it so happens that the possible combinations of altitude and Mach No. in which it is practicable to advance are quite limited. This is especially true if one is considering stabilized continuous flight; in fact, there is only a narrow channel which spans the distance from the advanced research aircraft to manned satellites. This channel is referred to as the "Corridor of Continuous Flight" and its extent and location are shown in Fig. 3. (Note that scales are compressed in the direction of higher speeds and altitudes.) The exact boundaries of this flight corridor (Refs. 3 and 4) are somewhat dependent upon the assumptions involved as to the state of the aerodynamic art on the upper side, and the materials and structural considerations on the lower side. It is, therefore, reasonable to expect that there will be some differences between various versions of this chart now appearing in the literature but for the most part they are not too important.

Fig. 1

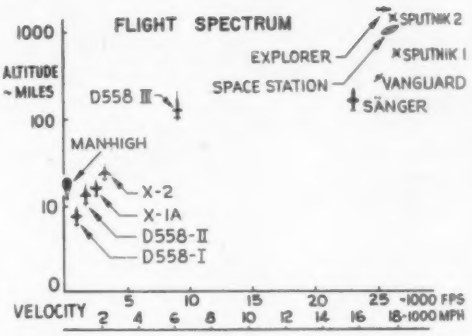


Fig. 2.

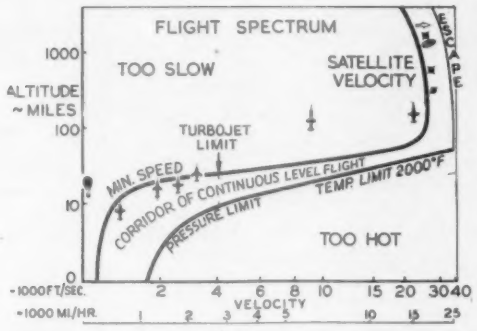


Fig. 3.

Lift Boundary.—The upper boundary line is the minimum speed at which continuous flight is possible, hence at low speeds this is a function of the aircraft configuration, i.e., weight, wing area, aspect ratio and power available. By radical changes in configuration it can be pushed upward, but at a sacrifice of other capabilities of the aircraft. Possibilities of this sort are shown in Fig. 4, which illustrates the gains in altitude obtainable by large reductions in wing loading; however, for an average-type configuration capable of supersonic flight, the minimum speed is of the order of 170 m.p.h., which is the value used as a boundary. At very high speeds it is obvious that the aerodynamic lift will be augmented by centrifugal force and eventually at satellite speeds the centrifugal force supplies the entire lifting force to keep the vehicle in orbit.

Temperature Limit.—The lower boundary of the corridor is essentially a temperature limit (except for the extreme left portion which is restricted by the maximum engine pressure) and, as such, depends largely upon the type of material of which the vehicle is constructed. It is, of course, assumed that the basic structure is critical and that sufficient cooling is provided for the equipment and the pilot. It is especially important to emphasize that this limit is established on the basis of stabilized—not transient—conditions, and, therefore, may be too extreme for vehicles operating over a short time. It is also to be expected that this limit will be pushed to lower levels by future improvements in materials, the development of flexible external insulating coatings, more efficient cooling systems, specially designed structures, and especially by increased aerodynamic knowledge of boundary layer and heat transfer phenomena. The boundary shown for this particular chart is based on the assumption of utilizing the best currently available materials, i.e., so-called "super alloys" of steel and even in these cases special treatment is necessary at stagnation points to avoid loss in strength.

In Fig. 5 additional temperature lines are used to show the limits of other common types of structural materials that may be used. For example, the best aluminium alloys rapidly lose their efficiency at temperatures over 350° F., while titanium alloys can be used up to temperatures of 800° F., and stainless steels up to 1,200° F. These limits have been established by considering the strength/density ratio, F_{TU}/d for tension, and the compressive efficiency factor, Et^3, where E is the elastic modulus and t is the thickness of the material, as functions of temperature for the best currently available materials in each metal family. These characteristics are charted in Figs. 6 and 7 (Ref. 5).

Propulsion Limits.—For moderate speeds and altitudes, the turbojet has proved to be an efficient and reliable type of power-plant, but, because it depends upon air-breathing, it will have an altitude limit at each given speed beyond which it cannot function simply because there is insufficient air to sustain combustion; however, the combustion limit lies outside the flight corridor and hence is not critical. A lower limit for turbojet engines is established on the basis of inadequate structural strength; but while this forms the low-altitude portion of the corridor boundary, there is also a limit on the speed or Mach No. at which an air-breathing engine can operate and still be efficient. This is simply because the intake air is compressed and raised to a very high temperature which increases with speed, while metallurgical requirements impose a fixed limit on the temperature at some point in the engine. The allowable temperature rise due to combustion is, therefore, reduced as the Mach No. is increased, and a point will eventually be reached where no energy can be added by combustion. While future developments may push out this limit, currently foreseeable practice indicates that the thrust capability of the turbojet will decrease rapidly as the Mach No. is increased beyond about 4.0. This limit is indicated by the vertical arrow on the flight corridor, Fig. 3.

Indications are that ram-jets may be pushed to somewhat higher speeds than turbojets and for even greater speeds an interesting hybrid engine, termed the ram-rocket, shows promise (Ref. 6). It is obvious, however, that to go to the highest speeds and altitudes, rocket-propelled vehicles, which do not depend upon the existence of an atmosphere, are necessary. Actually, rocket power not only makes it possible to fly faster and higher, but for ranges greater than half way around the earth or 12,500 statute miles, they can actually be more efficient than vehicles powered with air-breathing engines. This is conclusively shown in the recent Wright Brothers Lecture by H. Julian Allen of the N.A.C.A. (Ref. 7).

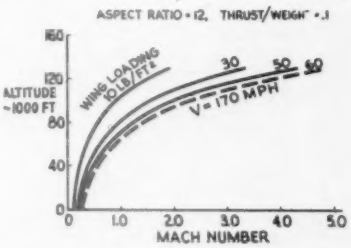


Fig. 4. Effect of wing loading on minimum airspeed.

Looking back at the composite chart showing the flight corridor, again it should be emphasized that this corridor represents the speed and altitude at which stabilized flight is feasible and that advances in altitude and speed of manned vehicles will progress toward eventual achievement of manned satellite and space flight within these general limits. It should, however, be remembered that these limits can be exceeded for short time periods on either side—the upper by dynamic flight, the lower by very short transient flight paths which do not permit the skin temperature to stabilize. Fig. 8 shows that the decelerating phase of most calculated re-entry paths for satellites, boost-glide and ballistic vehicles, as well as the D-558-III, fall within the corridor.

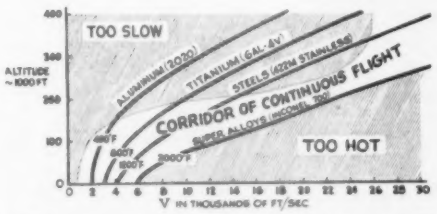


Fig. 5. Flight spectra of various materials based on equilibrium.

D-558-III Design Configuration

The primary objective of the D-558-III study was to design a manned aircraft capable of attaining very high altitudes and very high speeds for the purpose of investigating the aerodynamic, structural, operational and human factor problems involved in these flight régimes as a step towards space travel. To avoid costly delays in time it was considered important that the aircraft be straightforward, simple and capable of being constructed in a short period of time. Extensive configuration studies to determine the aerodynamic optimum for flight at high speeds and altitudes were not necessary, since the purpose was to find out and explore the problems of high-speed, high-altitude flight, rather than to avoid them. Another important

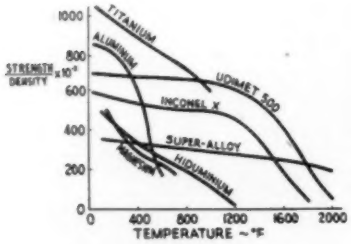


Fig. 6. Tension efficiency v. temperature.

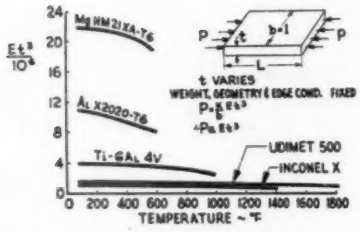


Fig. 7. Compressive efficiency v. temperature.

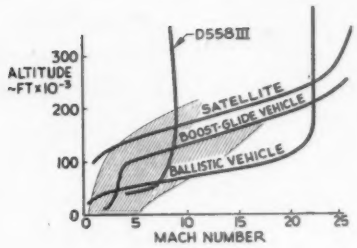


Fig. 8. Re-entry paths.

requirement was that it possesses normal flying characteristics through the entire speed range. The final design configuration is, as always, a compromise between these and many other, and often conflicting, desiderata.

First of all, the wing area (or wing loading) is dictated by having a moderate landing speed so that the aircraft may be landed safely; and, secondly, the wing area should be sufficient so that a satisfactory pull-out can be made without undue stress upon the pilot. These requirements are, of course, complicated by the aerodynamic heating problem which, in vehicles of this type, plays an important rôle in determining the configuration and weight.

Since, as will be shown later, a good portion of the flight is out of the earth's atmosphere, drag becomes of secondary importance in comparison with aircraft weight. For this reason, and because it is desirable to have satisfactory low-speed characteristics, the wing leading-edge is a conventional elliptical nose-type section rather than the sharp-nose section which gives minimum drag at supersonic speeds. The rounded leading-edge, as discussed later, also is effective in avoiding severe aerodynamic heating problems. On the basis of the introductory discussion on propulsion systems, the rocket engine was the logical choice of powerplants to meet the objectives of very high altitudes and very high speeds.

Flight Paths

Because the purpose of a manned research vehicle is to obtain information of all types at very high altitudes, it is necessary to investigate the best method of achieving altitude. A variety of flight paths are possible in hypersonic flight, but they may be roughly classified into three basic types—ballistic skip, and boost-glide. Assuming other factors constant, it is obvious that the ballistic path is most suitable for attaining very high altitudes, as shown in Fig. 9.

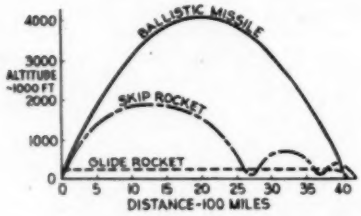


Fig. 9. Typical trajectories for hypervelocity vehicles.

The initial goal for the D-558-III study was an altitude of one million feet or approximately 190 statute miles. Investigation indicated that such altitudes were only feasible with some sort of two-stage vehicle. A two-stage vehicle could consist of the basic aircraft and a first-stage rocket booster or, alternatively, the aircraft could be carried aloft by a mother ship and launched from altitudes around 40,000 ft. In the interest of safety and economy, as well as immediate practicability based on previous experience with recent research aircraft, it was decided to utilize the mother-ship technique rather than a first-stage rocket booster.

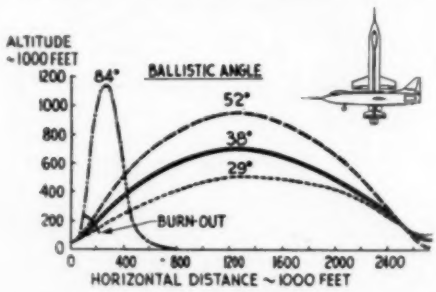


Fig. 10. Flight paths.

The method of obtaining maximum altitude was to start the rocket motor immediately the aircraft fell free from the mother ship and to pull up into a climb. Obviously the highest possible altitude could be obtained by using a very steep angle at the end of burn-out. Several flight path angles were investigated and are shown in Fig. 10. The maximum value of the angle at end of burn-out was 84°. This flight path, however, results in very high resultant g forces on the pilot during pull-out on re-entry to the atmosphere. Progressively lower flight path angles were investigated until a tolerable g load on the pilot was obtained as shown in Fig. 11. Characteristics of this flight path are that the flight path angle at burn-out was 38°, maximum height reached is 750,000 ft. (approximately 140 miles), and the maximum resulting load factor on the pilot is 10.2g. This flight path is considered reasonable and marginally acceptable so far as the load factor is concerned. It should be noted, however, that it is possible to build up to this condition by making progressively steeper pull-ups and thus find out exactly what is tolerable. For example, 29° angle at burn-out results in a peak altitude of 560,000 ft. and a peak load factor on the pilot of 7.5g.

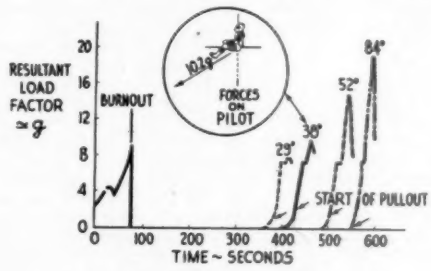


Fig. 11. Resultant load factor v. time.

Aerodynamic Heating

Because aerodynamic heating is one of the most serious problems that is encountered in high-speed flight or on re-entry into the earth's atmosphere, much effort was taken to study flight paths along with suitable materials and techniques for keeping the attainable temperatures within reasonable limits.

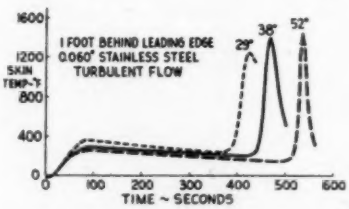


Fig. 12. Skin temperatures along various flight paths.

The influence of the flight path on skin temperature 1 ft. behind the leading-edge, is shown in Fig. 12. As we have demonstrated, the design path of 38° was chosen by the resultant load factor on the pilot; but less severe heating problems can be generated by the choice of flight paths having lower

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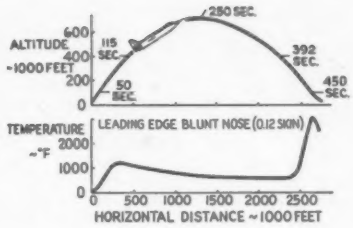

Fig. 13. Temperatures along flight path.

(*Continued from page* 628)

maximum altitudes and thus the problem of aerodynamic heating can also be explored gradually by building up to the design flight path in easy steps.

The most critical part of the aircraft from an aerodynamic heating viewpoint is the wing leading-edge or stagnation point. The variation of the temperature of this critical point is shown along the design flight path in Fig. 13. A more typical value of the skin temperature 1 ft. aft of the leading-edge has been computed and is shown in comparison with the stagnation value at the leading-edge in Fig. 14. It may be remarked that although very high values of temperature do occur, the time for which they persist is quite short, being of the order of 50 seconds duration.

Various methods of reducing the skin temperature were studied for the design flight path. One method is by employing a blunt leading-edge on the wing aerofoil and Fig. 15 shows the effect of such bluntness on the D-558-III wing leading-edge during its flight path. It is pertinent to note that the use of leading-edge bluntness is a general phenomenon and has applications to all types of re-entry vehicles. This idea was originally advanced by Allen (Ref. 8) and depends upon making the wave drag a large proportion of the total drag, thereby reducing the skin friction which gives rise to the aerodynamic heating.

Another method of reducing skin temperature is to increase the thickness of the material and thus the heat sink capacity in the critical areas; this is exemplified in Fig. 16, which illustrates the effect of doubling the skin thickness. Appreciable reductions in skin temperature can also be attained by using exterior insulating coatings as charted in Fig. 17. It is seen that this is one of the most effective methods of reducing skin temperatures and hence the development of a suitable insulating coating should be vigorously pursued.

It is also extremely important to know the type of boundary layer over the aerofoil surface. This is because the heat transfer coefficient which determines the temperature attained within a given time period is many times as large for turbulent flow as for laminar flow. Typical values of the heat transfer coefficient for laminar and turbulent flow over a flat plate are shown in Fig. 18. The boundary-layer type, therefore, can markedly affect the weight of the structure since if it is certain that a laminar boundary layer exists the structure can be made

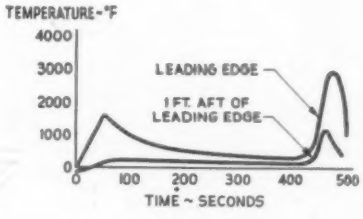

Fig. 14. Skin temperatures.

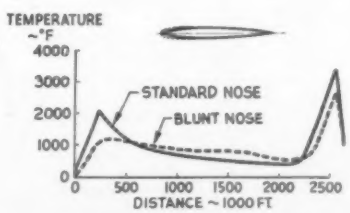

Fig. 15. Effect of nose radius on temperatures at leading edge.

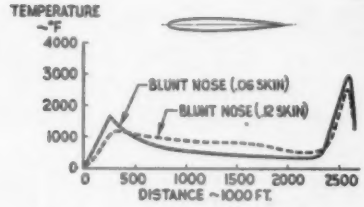

Fig. 16. Effect of skin thickness on temperatures at leading edge.

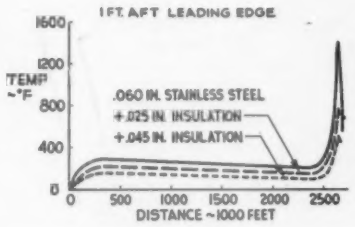

Fig. 17. Effect of exterior insulation on skin temperatures.

considerably lighter than for the case of a turbulent boundary layer. Unfortunately, however, information on the boundary layer type is in a very confused state, hence it is extremely hazardous to predict which type will occur for a specific configuration under a specific flight condition. The possible difference in temperature on a specific configuration is illustrated in Fig. 19.

(*To be concluded*)

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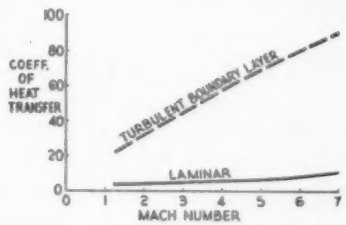


Fig. 18. Heat transfer coefficient v. Mach number.

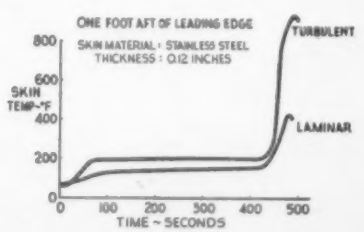


Fig. 19. Skin temperatures for laminar and turbulent flow.

From the Lecture Room

Ballistics International

WITH the emphasis now firmly on space flight and ballistic missiles, it was timely that the Advisory Group for Aeronautical Research and Development (AGARD) of NATO should have arranged a meeting on ballistics from April 22 to 25.

Organized by the Wind Tunnel and Model Testing Panel of AGARD, the meeting was held at the Festival Auditorium of the University of Freiburg, Germany. On the evening preceding the start of the meeting, 185 delegates attended an introductory address by Prof. Dr. Th. von Kármán on "The Scientific Co-operation of the NATO Countries."

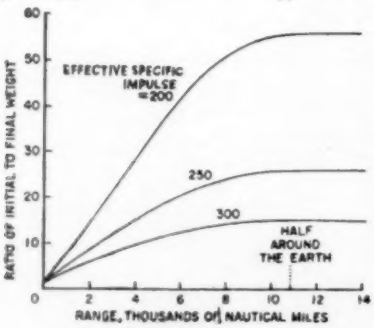
"In recent years there has been expended a considerable effort greatly to increase flight range of projectiles through the application of rocket propulsion. That these efforts have met with success is well known. Contrary to the case for short-ranged projectiles, for long-range ballistic rockets aerodynamic forces have relatively unimportant effects as regards their influence on flight range, since practically all of the flight occurs in near-vacuum. Thus, with the effects of Earth rotation and the contribution to range of the short trajectory of the powered phase of flight neglected, the ballistic trajectory becomes one of Kepler's planetary ellipses. For the trajectories of interest for which the flight speed is less than or equal to satellite speed, the far focus of the ellipse is at the mass centre of the Earth. For purposes of range computation, then, this ballistic vehicle leaves and returns to the Earth's surface at the same absolute magnitude of speed and incidence.

LECTURE PROGRAMME AT FREIBURG

"Historical Talk on Prof. C. Cranz" - - - *by Prof. Dr.-Ing. H. Schardin*
"Forty Years of British Aeroballistic Research" - - - - *by J. W. Macoll*
"Exterior Ballistic Developments in the U.S. Since the Time of Cranz" *by C. L. Poor*
"Some Aerodynamic Effects on Long-Range Rocketcraft" - - *by H. J. Allen*
Papers on the Explorer Satellite
by Dr. J. Froehlich, A. R. Hibbs, Dr. R. Hoeller and Dr. E. Neubert
"Meteorites and Ballistics" - - - - - - - *by Dr. J. S. Rhinehart*
"Projectile Ballistics" - - - - - - - - - *by R. Sauer*
"Prediction of Stability and Damping of Projectiles" - *by Prof. Dr. W. Haack*
"The Rôle of Free Flight Ranges in Ballistic and Aerodynamic Research"
by Dr. C. H. Murphy
"Electronic and Optical Means of Observation of Guided Missiles and Satellites"
by Dr. L. A. Delasso
"Special Ranges" - - - - - - - - - *by Dr. H. H. Kurzweg*
"Electrical Arc Discharge Gun Experiments" - - - - *by R. W. Perry*
"Forty Years of British Internal Ballistic Research" - - - *by J. B. Goode*
"A Brief History of Rocket Research and Development in the U.K." *by F. James*
"On the Secondary Jet Effects of Self-Propelled Missiles" - - *by Ing. Tesson*
"Scaling Problems in Underwater Ballistics" - - - - *by Dr. H. G. Snay*

Of the papers available, "Some Aerodynamic Effects on Long-Range Rocketcraft," by H. J. Allen, NACA, Moffet Field, California, U.S.A., was of special interest. Extracts follow:—

"In the first volume of his famous work 'Ballistik' Dr. Cranz discussed at considerable length the equations of motion of a bullet in flight. Although he discussed long-range and satellite trajectories, his principal interest was restricted to gun-launched projectiles for which, for practical reasons, the maximum speeds attained are of the order of only several times the speed of sound. In such cases, the projectile throughout its flight remains in the lower, denser regions of the atmosphere so that aerodynamic forces play an important rôle over the whole range of flight in determining the stability of the projectile and its flight range and deflection.



Weight ratio for ballistic rockets.

"In spite of the fact that the presence of the Earth's atmosphere has only a minor effect on range, its presence has a controlling influence on design. This influence of aerodynamics is felt particularly in the final phase of flight—the descent through the atmosphere.

"Every pound of unnecessary weight for the empty vehicle requires many pounds of added weight for the vehicle at take-off. Hence it is vital in the design of a long-range ballistic rocket to be most prudent to avoid unnecessary additions to the empty weight of the vehicle.

"The portion of the empty vehicle which is required to descend intact through the atmosphere on the final plunge to Earth, which I shall call the 'entry body,' may be subjected to large decelerations due to aerodynamic drag. One important aerodynamic consideration, then, is this drag, since it may determine to an important degree the structural weight of the entry body. Secondly, the total energy possessed by the entry body just prior to its descent through the atmosphere is approximately its kinetic energy.

"As will be seen later, the speed at impact with the Earth will generally be small compared to speed at the end of rocket boost so that nearly all of this energy must be converted to heat before impact occurs. If even a minor fraction of this heat energy is convected to the entry body, a large weight of coolant might be required to be added to the entry body to prevent its destruction.

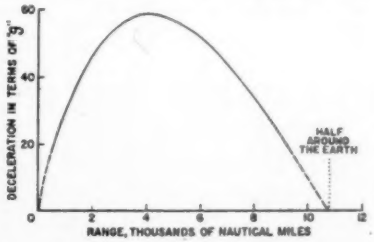
"The heat convected to the vehicle may be minimized by making the frictional force as small as possible compared to the drag. In other words, one should employ blunt entry bodies which have high pressure drag. In this way the majority of the energy appears as heat within the atmosphere (wasted in the shock waves and wake) and only a minority must be absorbed by the entry body. The use of blunt compact entry shapes is also desirable to best resist deceleration loads.

The Recovery of Space Vehicles

"There is, at the present time, considerable attention being given to the problems of space travel. One facet of interest is the recovery of space vehicles onto this or other planets. There arise such questions as 'How can recovery best be effected?' 'Do the atmospheric decelerations permit human occupancy of the vehicle?', etc.

"One age-old method proposed for effecting a successful landing on a planet is to employ retrograde rockets to decelerate the vehicle during the approach to the planet. That such a scheme does not appear to be practicable with present rockets is readily apparent.

"A more attractive scheme is to employ aerodynamic drag to brake the vehicle. The vehicle is assumed to approach the Earth at a speed greater than Earth satellite speed along a near-tangent path. This path is chosen to cause the craft to experience aerodynamic drag and so to decelerate slightly as it cuts across a segment of the atmosphere.



Maximum deceleration for minimum energy flight of ballistic vehicles.

The craft then proceeds on a near-elliptic orbit so that it returns to experience a second pass through the atmosphere. On each pass, the axis of the ellipse is precessed and the apogee is diminished. Ultimately, the speed is reduced to near satellite speed, and the orbit becomes more circular. On the craft's final pass its speed is braked to less than satellite speed. Then as the speed drops, the path becomes inclined more and more steeply toward the Earth. Eventually the speed becomes a small fraction of satellite speed and the path is nearly vertical. Prior to impact with the Earth, a parachute may then be deployed to effect the landing

"As regards the aerodynamic heating experienced by satellites, the rates of heat input are considerably less than for the long-range ballistic rockets previously discussed. Thus re-radiation of an important fraction of the convected heat is possible, which should generally serve to minimize the importance of the heating problem in the recovery by atmosphere braking of space vehicles."

Flying the Agricultural Super Cub

by John Fricker

EXECUTIVE and agricultural flying have both undergone a steady expansion in the United Kingdom during the past few years, but the latter activity has proved particularly successful, and several companies are operating substantial numbers of crop-spraying or -dusting aircraft at home and overseas. The most recent addition to their ranks is Farmair, Ltd., whose offices are at Hatfield, Herts., but although new to flying, this company is the subsidiary of Sheriff and Sons, Ltd., one of the oldest agricultural concerns in the country.

Aerial spraying and dusting are logical extensions of the existing ground services offered by this company, and Farmair also has the benefit of the extensive experience with agricultural aircraft of Brian Collins, its chief pilot. On the basis of his operational background in the United States, the Piper PA-18A Super Cub was selected as the most economical and well-tried agricultural aircraft then available, and the necessary import licences were eventually obtained from the Board of Trade. The first Super Cub, G-APKB, arrived as air cargo at Shannon earlier this year and was later flown to England, where it may be joined by two more for Farmair.

As the latest version of what is undoubtedly the oldest aircraft design still in production, the Piper PA-18A, with its 150-b.h.p. Lycoming 0320 flat-four engine, has almost five times the power of the original Cub of the early '30s but, apart from this and the addition of flaps, the airframe has undergone remarkably little change. The time-honoured and durable steel-tube fuselage has been retained, with the same tandem cockpit layout, but the fuel tank behind the front coaming has disappeared in favour of wing-root tanks, each with a capacity of 15 Imp. gal. There is also a 90-b.h.p. version of the PA-18, which uses only one wing tank.

The Super Cub "95," as the lower-powered PA-18 is known, differs even less from the original airframe in being without flaps and having similar tail surfaces, but the "150" has a larger tailplane and aerodynamically balanced elevators. The wing span remains the same as the 1930 figure in all cases, however, and the accessible external aileron cable-runs along the wing struts have been retained, but the only wood now left in the fabric-covered wing is found in the springy ash wing-tips.

In the cockpit, which is entered by the standard Cub hinged door and window flaps, the only noticeable differences are the addition of flap and hopper levers, and a fuel selector lever forward of the tailplane trim crank, all on the port side. The efficient heater was a welcome feature, while an innovation was the extension of the mixture control to an idle cut-off position for engine stopping. The primary instruments on the front panel are supplemented in the PA-18A by a pressure gauge for the spraying gear, and there is also a long glass tube running round the door frame to indicate the spray-mixture level.

The rear cockpit, in the agricultural Super Cub, is entirely occupied by an 18-cu.-ft. aluminium tank, which has a capacity of 110 gal. of liquid, or up to 6 cwt. (officially 650 lb.) of solids, for spraying or dusting respectively. When I flew G-APKB it was doing an actual job of top-dressing on a farm near Hatfield and had a dispersal venturi under the fuselage, but in its agricultural form the Super Cub is sold as a complete unit, with spray booms, windmill pump and dusting attachments, for rapid conversion. The PA-18A also has quickly removable metal panels under the rear fuselage, instead of fabric, to facilitate cleaning and inspection; sharpened cutting edges on the undercarriage legs to penetrate wire obstructions; and a heavy-duty shoulder harness for the pilot.

The agricultural PA-18A is licensed to a maximum gross weight of 2,070 lb., instead of the normal 1,750 lb. of the standard PA-18, and on removal of the tank installation may revert to the normal dual-control two-seat cockpit or the space used for light freight. The manufacturers claim that the PA-18A, when fitted out for spraying, can distribute from 1 to 10 gal. of liquid per acre, through up to 46 quick shut-off nozzles, while for top-dressing it is said to be capable of spreading up to 12 tons of fertilizer per hour under good conditions. The normal maximum in the latter case, however, is about six tons per hour.

In the past, aerial spraying or dressing has been rather more

Above, access to the hopper of the Piper PA-18A is quick and convenient, while (above, right) the cockpit is similar to earlier Cubs, except for hopper and flap controls. On the right, the author is seen taking off from a small strip of pasture in the Super Cub, which is fitted with a venturi spreader for top-dressing, beneath the fuselage.

Photographs copyright "The Aeroplane"

expensive than comparable ground treatment, but the operating cost of the Super Cub enables, for example, potato-blight spraying to be offered at about £2 per acre per dressing, including the chemical, and top-dressing with nitro-chalk fertilizer at 15s.-£1 an acre at 2 cwt. per acre spread. Although this is slightly more than ground treatment, it offers compensating economy in eliminating wheel damage to the crop (which, in the case of potatoes, frequently amounts to a loss of 15 cwt. per acre) and a considerably quicker coverage.

These rates can only be achieved by reducing non-productive flying, and the time spent on the ground, when operating, to a minimum. The aircraft must therefore fly from the same site as that being worked, which presupposes an excellent field performance with a maximum load, and loading between flights must be performed with the engine running for the quickest possible turn-around. During the demonstration at Hatfield, Brian Collins flew the Super Cub from a rough pasture field about 300-yd. long adjacent to the area being fertilized, with no intervening obstructions, and the reloading vehicles were grouped at the farther end of the operating strip.

He took off downwind in the slight breeze, occasionally running gently on to the ploughed field, thereby emphasizing the need for the big low-pressure tyres on the Cub, and was then immediately over the working site to begin dusting. On emptying the hopper after a few minutes he landed into wind, stopping just in front of the reloading vehicles to avoid taxi-ing, and was off again with a full load in a matter of 1½ min. The access hatch to the hopper in the Cub is conveniently situated at about shoulder height at the rear of the centre section, and the standard tractor-carried loader tips in the entire 6 cwt. in a few seconds.

My flight in the PA-18A was an unusual opportunity to assess an aircraft under truly operational conditions, and although I used another section of pasture the breadth of which was more or less into wind, only 250 yd. or so of grass was available with ploughed land on each side. I had been concerned at first at the apparent lack of ground clearance for the dusting venturi, but even with a full load deflecting the simple bungey undercarriage shock absorbers and on undulating, long-grassed fields, there was never any problem. Apart from the big mainwheels, the bumps in the unprepared surface were smoothed out to a remarkable degree by the 8-in. pneumatic tailwheel and extra leaf spring, which is a worthwhile optional fitting for this sort of job.

A refinement over the earlier Cubs, made possible by the installation of electrics into the airframe as an extra feature, is a starter unit which springs the Lycoming into lusty power at the touch of a button. Pre-take-off checks in so simple an aeroplane are limited to the application of slight aft tailplane trim, via the low-geared crank; selecting the appropriate fuel tank and checking the eye-level gauges; pushing forward the mixture plunger to fully rich; and lowering the first stage of flap with the press-button manual lever.

Like most light American powerplants the Lycoming requires very little warming-up and, except in the coldest weather, the typical "Cub" throttle can be fully opened for take-off within 2 min. of starting. During the brief take-off run little rudder is needed to keep straight, and tailwheel steering is available until the tail is raised. The Super Cub then unsticks at about 50 m.p.h. and the climb-away at 70-75 m.p.h. results in a very steep angle. As one would expect, the Sensenich metal airscrew of the PA-18A is of a fairly fine pitch for take-off and climb performance, and allows the full 2,700 r.p.m. for the rated power of the Lycoming to be achieved.

With a light load on board, G-APKB climbed away at well over 1,000 ft./min., and at the maximum weight the rate is still more than 700 ft./min. In the air the PA-18A retains the pleasant handling characteristics of the earlier Cubs, the ailerons in particular remaining light and responsive, but there has been a considerable increase in longitudinal stick forces, as one might expect from the enlarged elevator area. To a lesser degree, the same remarks apply to the rudder, but the forces involved are nowhere near excessive and are perhaps inevitable in view of the substantial increase in engine power and weight.

Another effect of this increase, and the bigger adjustable tailplane, is the appearance of some noticeable trim changes, with alterations of power, airspeed or flap setting, and while they can all be easily held with one hand, the other is kept fairly busy if zero control loads are required. As agricultural flying is done at a reduced airspeed of about 70 m.p.h. with half-flap, trim changes are reduced in magnitude, and in any case they are apparently quite tolerable when dusting or spraying.

Many people consider a relatively heavy elevator control a good thing when manœuvring in confined air space near the ground with a heavy load, to avoid inadvertent stalls. This theory, one would imagine, is quite acceptable to the crop-spraying pilot providing, as in the Super Cub, the lateral control does not make him work too hard. I was slightly less happy, in steep turns, with the inevitable restriction of view in a high-wing monoplane, but the PA-18 is no worse than other types in this respect, and with its transparent roof is rather better than some.

Climbing up to about 1,500 ft. to try the stalling characteristics of the Super Cub, I was careful not to lose my tiny field in the mist below until the extra altitude disclosed the long Hatfield runway a short distance away as a convenient landmark. With power off and flaps up, resulting in a brisk nose-down trim change, the Super Cub could be pulled up until the airspeed hovered around the minimum reading of 40 m.p.h. before the nose started nodding in an incipient stall, and relaxing pressure on the stick immediately restored flying speed. With flap and a little power the aircraft could be stood on its tail with no readable airspeed before the mild breakaway after a brief pre-stall buffet.

So far as I could discover, the large dusting venturi had little effect on the handling characteristics of the Super Cub, although it may have contributed to the trim changes, and it obviously knocked down the cruising speeds by a few miles per hour. At 2,300 r.p.m. I found the cruising speed to be about 95 m.p.h., but clean, the PA-18 should cruise at 115 m.p.h. and 2,400 r.p.m. at 75% rated power. By judicious use of the mixture control, the consumption should then be about 8 g.p.h. Even when operating on agricultural flying, with a take-off and landing every few minutes, Brian Collins finds that the PA-18A uses only about 9 Imp. g.p.h.

For landing, flap can be lowered below 85 m.p.h. with the trim changes more or less cancelling each other out as the speed is reduced. With the full 50° of flap and no aft load, I found that slight nose-down trim was required to maintain about 60 m.p.h. on the approach. On my first approach, low across the ploughed field with a little power, this speed proved slightly fast and there was a brief float before a soft touch-down, and a gentle run into the next bit of soft ground. I could have checked the run with the heel brakes but I was curious to see how the Super Cub coped with really bad surfaces. The low-pressure wheels, however, provided ample float.

A second landing at a lower approach speed resulted in a precise touch-down and a short run within the available grass area. It concluded some pleasant impressions of an economical, rugged and well-tried vehicle, which has proved its versatility in 34 countries all over the world. As the largest light aircraft manufacturers in any country, the Piper Aircraft Corporation delivered, late last year, its 45,000th machine, so that the PA-18 has a vast development background behind it. Its cost, as delivered to the U.K., is very reasonable at about £4,500.

Leading Particulars

DIMENSIONS.—Span, 35 ft. 2½ in.; length, 22 ft. 6 in.; height, 6 ft. 7 in.; gross wing area, 178.5 sq. ft.

WEIGHTS.—PA-18A, empty, 1,126 lb.; fuel (30 Imp. gal.), 216 lb.; oil (1.66 gal.), 15 lb.; crew, 170 lb.; max. commercial load (full fuel), 543 lb.; max. gross weight, 2,070 lb.

PERFORMANCE (at max. weight).—Max. speed, 128 m.p.h.; never-exceed speed, 154 m.p.h.; cruising speed (75% power), 113 m.p.h.; stalling speed (full flap, power off), 45 m.p.h.; initial climb, 725 ft./min.; service ceiling, 17,000 ft.; take-off run, 300 ft.; to 50 ft., 950 ft.; landing run, 410 ft.; cruising range, 460 miles.

PRIVATE FLYING

H.J.C.'s Club Commentary:

A Sales Centre

A Plea for British Lightplanes

Tiger Meetings

● DESPITE seasonal showers and a very cold westerly wind gusting up to 35 knots, a gratifying number of people turned up at Kidlington on April 26 and 27 for the sales week-end organized by W. S. Shackleton, Ltd. About 35 second-hand aeroplanes were on show, and with a similar number of visiting aircraft the aerodrome was as busy as it has ever been in recent years.

We understand that the organizers were pleased with the result. Several aeroplanes were sold, and there were enough tentative inquiries to suggest that the occasion was worth while. There is no doubt that the private-flying community as a whole thoroughly enjoyed what was in fact the first large-scale meeting of the season.

SALES GROUP.—Seen at Kidlington last week-end are (centre) Mr. W. S. Shackleton, who founded the firm, Mr. Keith Shackleton (left), and Mr. Frank Dismore.

● PRIMARILY responsible for the event was Frank Dismore, erstwhile R.Ae.C. assistant secretary, and now Shackletons' general manager, who asked Peter Clifford—1955 King's Cup winner and managing director of Goodhew Aviation, Ltd., which operates Kidlington Airport—for advice and co-operation in forming a selling centre. This help was readily given, and plans came to fruition as we saw. Certainly the occasion should create a precedent, and we were told that another will be held next year, if not later this year.

Since Bill Shackleton formed this company in 1931 it has grown steadily, and now instead of dealing almost entirely with light aeroplanes, as it did initially, all types of commercial aircraft are handled.

● ONE SAD THING about the event, through no fault of Shackletons, was that with little exception all the aeroplanes for disposal were of archaic design.

In this paper we have frequently deplored the attitude of this country's aircraft industry for neglecting to produce light sporting aeroplanes. Only one firm today is actively engaged—not counting conversions—in turning out light, as distinct from ultra-light, aircraft; for various reasons, primarily expense, these aircraft do not compare favourably with those being built on the other side of the Atlantic.

There are no British equivalents of the Cessnas, Luscombes, twin-engined Pipers and Beechcraft: all-metal aeroplanes of high performance, fully instrumented and comfortable, but indeed expensive.

● MOST British aeroplanes now used for private flying are ex-Service designs or at least 10 to 12 years old—Tiger Moths, Messengers, Geminis, Proctors, Hawk-Trainers (Magisters), Chipmunks and Prentices. Although their longevity is a laudable comment on the soundness of their basic design, there is obviously a limit to their development and conversion. No adaptation, however well executed, can hope to compare with an aeroplane produced specifically for a certain job.

What we want to see is some *new* aeroplanes primarily for training, touring and executive flying. Although the demand for them at home would not be great—for they will be expensive and money with which to buy them is limited—we as a nation still need to export. It is all very well for ultra-light types to be produced as a necessary interim measure, but acceptance of inferior designs—so far as performance is concerned—may lead to an effete and mediocre sporting-flying movement. That is better than none at all, but when it is remembered that, with the Moths, Avians, Percivals and Miles, we once led the World in light aeroplanes, today's picture is not a very inspiring one.

● TODAY we have almost completely lost to America the market for light aircraft all over the World, including the Commonwealth. Shackletons sold only one new British light aeroplane abroad last year—the demand all the time is for American designs which meet requirements and can be delivered quickly.

Now that orders for military aircraft are curtailed perhaps some of the bigger names in the British aircraft industry can consider whether or not the private-flying and business-aircraft markets are worthy of attention.

Photographs copyright "The Aeroplane"

FOR AEROBATICS.—The special red and yellow single-seat Tiger Moth (less the top tank) in which Mr. C. A. Nepean Bishop gave an impressive performance at Kidlington is also to be at Sywell on May 4.

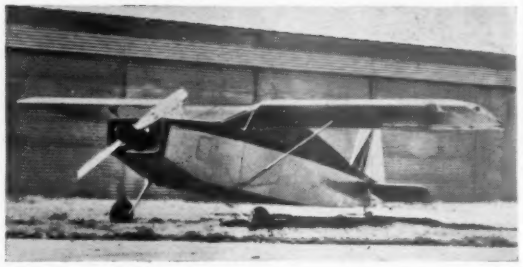
● ON SUNDAY next, May 4, the **Tiger Club** is to hold its second aerobatic competition for the de Havilland Trophy at Sywell aerodrome, Northampton.

In addition the club will put on one of its usual displays, including a short race and aerobatics by C. A. Nepean Bishop in, it is hoped, his specially equipped Tiger Moth. The Jackaroo and Turbulent will also be demonstrated, and members of the **British Parachute Club** are due to provide a show.

● THE NEXT event by the Tiger Club will be the race meeting at Sandown, Isle of Wight, on Whit-Monday, May 26. The race, for Tiger Moths, will

be over three laps of a five-mile course, and the winner will receive the trophy presented by Alderman Basil Monk, M.B.E., J.P., a vice-president of the Surrey Flying Club. The closing date for entries is May 12; applications should be sent to the secretary at 49 Zermatt Road, Thornton Heath, Surrey. The entry fee is £3 3s., which includes six months' membership of the club.

The meeting is being organized under F.A.I. regulations and the competition rules of the R.Ae.C.



SQUARE-RIGGED.—This small American aircraft, the prototype of which is shown, is the Nesmith Cougar. The backward-raked undercarriage is interesting.

(Howard Levy photograph)

● FLYING TIME at the **Lancashire Aero Club** amounted to 199 hr. 20 min. in March, of which 74 hr. 40 min. was made up of A.T.C. air-experience flying. The total for the 10 months to March 31 was 1,476 hr. 50 min. The aim was to fly another 200 hr. each in April and May and so achieve 1,900 hr. for the 12 months, averaging 380 hr. per aircraft as in 1957.

First solos have been flown by Messrs. Woodall and Brayshaw.

The club is to publish its own 28-page periodical shortly, entitled *Elevator Magazine*, and members' annual subscriptions are accordingly to be increased by 2s. 6d. as from June 1. Starting off in a modest way, the paper is eventually to become a quarterly.

● BY JULY the **Wiltshire School of Flying** at Thruxton should have a fleet consisting of six Jackaroos, three Tiger Moths and four Proctors. The Autocrats have disappeared and the two Taylorcrafts, G-AHXE and G-AHGW, are to go soon.

Present flying rates, dual or solo, are £3 15s. an hour on the Jackaroos, Tigers and Taylorcrafts.

The new C.F.I. is Sqn. Ldr. R. J. Honeyman, who was senior ground instructor at the C.F.S. and holds an A.1 instructor's certificate.

Although this club, like many others, has suffered from the generally unsuitable weather, three members—Messrs. E. M. Appleby, A. H. Campbell and C. H. Hammerton—have gained their P.P.L.s recently. Messrs. Patterson, Reynolds, McCarthy, Milward and Hadley have begun training. The last named is from Jamaica and is after his C.P.L. A.T.C. cadets now training are D. C. Thompson, R. G. Slade, K. J. Henley, D. J. Sawyer, P. R. Jones, N. J. Nosworthy and C. J. Dark.

● FROM CROYDON, A. J. Whittemore (Aeradio), Ltd., inform us that maintenance of the aircraft of the Surrey Flying Club is now in their hands. This company has for hire a Proctor 4 equipped with 50-channel VHF, Bendix ADF with 75 Mc/s receiver and S.C.S.51 ILS. It is used by the Airways Aero Club and is charged to members at £9 an hour.

GLIDING NOTES

INSTRUCTIONAL lectures are being given every Tuesday evening in May by Derek Piggott at the Kronfeld Club, 74 (Basement) Eccleston Square, near Victoria Station, starting on May 6 at 20.00 hrs. They are laid on specially for people intending to take a gliding course or join a gliding club, though others can be admitted if space permits. The subjects of the lectures are: first training flights; stalling; launches and landings; and soaring.

The fee for the four lectures is 10s., to be made payable to the Kronfeld Club and sent to the British Gliding Association (19 Park Lane, London, W.1). Those turning up without booking can be admitted at 3s. a lecture if there is room.

Derek Piggott, who is chief instructor at Lasham, has recently acquired two new additions to his staff of instructors: John Messervy and Gordon Cornell. Messervy has come over specially from New Zealand, having to work his way on the boat because there were no passenger berths available; he has been chief instructor to the Canterbury Gliding Club in South Island for the past 18 months, and last January climbed to 21,000 ft. in a wave, with a height gain of 13,000 ft.

Lasham has now three Tiger Moths for aero-towing. A rally will be held there at Whitsun.

* * *

JUST as the Midland Club's Easter Rally was over, a party arrived from Cranwell R.A.F. College for a week's stay, bringing a Tutor, Prefect, T-21 two-seater, and a privately owned Kite 2b which two of their members share. The party included Flt. Lts. R. A. E. Dunn (in charge). D. S. Bridson, R. N. Taylor and D. J. Edwards, all of whom help to run the gliding club at Cranwell in their spare time. They maintain its continuity while the cadets, who usually stay there three years, come and go; but at any one time there are about 100 of them in the club, or one-third of the total number at the College.

Ten cadets came with the party. This was their first visit to Long Mynd, as they usually go to Camphill for their slope-soaring holidays. One of them, Flt. Cdt. Delafield, had a Silver "C" certificate already, and during the camp Flt. Cdt. Strachan obtained his with a flight of 5 hr. and another in which he went 63 miles to Aston Down in the Kite, climbing the required 1,000 m. on the way.

* * *

NATIONAL RECORDS were set up during the week-end April 12-13 not only in England but in Ireland, where Michael Harty, of the Dublin Gliding Club, took off by auto-tow from Baldonnel in his Kite 2 and in 4 hr. flew 85 miles to Donohill, three miles from Tipperary. Another pilot, Con McNulty, flew 34 miles to Stradbally, Co. Laois. The previous Irish distance record was 60 miles, set up by J. Bellew two years ago.

As to flights in England that week-end, news of more and more keeps coming in. One pilot, J. K. McKenzie, managed to do cross-countries from both Lasham and Dunstable the same day. On the Saturday he was towed from Lasham to Cambridge, where he released, only to find that he had started too early. He struggled 37 miles to a landing at Redbourn, was taken by road the few miles to Dunstable, given a launch there, and flew back 52 miles to Lasham.

Alfred Warminger, who keeps his Skylark 3 at Swanton Morley in Norfolk, does not have to indulge in expensive aero-tows up-wind to give him a good start for a run to south-west England. On the same Saturday he found "magnificent soaring conditions" not only over West Norfolk but over the Fens, which most soaring pilots try to avoid. But he could not get away till 11.40 hrs. and after an hour the clouds began to flatten and disappear, so he got no farther than Bedford.

So many flights ended beyond Dartmoor that the old controversy on the best way to by-pass that high plateau has been lit up again. Wally Kahn and John Williamson went over the top, and on crossing Princetown Gaol (1,761 ft.) found themselves below the top of the 750-ft. radio mast.

The three pilots who flew to Plymouth from Dunstable—Norman Preston in a Gull I, John Westhorpe in a Skylark 2 and Charles Ellis in a Skylark 3—all kept south of Dartmoor, using thermals from slopes which faced the sun and were sheltered from the northerly wind. But Mrs. Anne Burns circumvented it to the north, following the Exeter-Okehampton road.

Other clubs also contributed to the day's total mileage, which at present I make to be 3,025. Chris Riddell flew his Skylark 1 75 miles from Sutton Bank to Ashbourne; Chris Hurst from Oxford, and two unnamed pilots from Coventry and R.A.F. Bicester all reached the Dorset coast near Bridport (105, 128 and 109 miles), and Ronald Sandford went 160 miles from R.A.F. Andover to near Newquay in trying for Land's End.

Next day, when David Ince broke the U.K. distance record, five people flew away from the Bristol Club at Nympsfield; among them Peter Scott completed his Gold "C" with 186 miles to Land's End, and Peter Collier missed the same goal by five miles.

* * *

TWO of the machines entered by the British team in the World Championships were taken out for exercise on Sunday, April 20. Philip Wills, in the Skylark 2 which he is to fly, and David Ince, in the Olympia 419 which Tony Deane-Drummond is to fly, both went round a 100-km. triangle from Lasham in a 15-knot wind. Also three pilots, Geoffrey Barrell, Bernard Davy and Brenda Horsfield, were all sent off in Skylarks 42 miles to Kenley to get their Silver "C." Thermals around Kenley were fantastically good, Brenda Horsfield writes, and one could do steep turns in them while still going up at 20 ft./sec. But at Lasham they maintained John Gibbon for just 4 hr. 48 min. instead of the 5 hr. he needed.—A. E. SLATER.

CORRESPONDENCE

The New Nomenclature

I DON'T know if this week's issue of THE AEROPLANE will already be full of correspondence about a substitute for Space-ships [see editorial of April 11]: "Astronaves" is quite good but I wonder whether anything could be cultivated out of the motto of the dying R.A.F. and so be a fitting memorial for the future—"Astrard," for example.

"Cosmos" might have been a better root for the writers to work on; these original terms have a habit of sticking and become misnomers. Almost certainly, "Sputnik" will remain for certain types of vehicle, however.

One could expand a lot on this subject, of course, but we need only recall the terms "Tank" (coined as a security measure but now official), and the use of the adjective "Submarine" for all undersea craft no matter what their purpose. So Space-(something) might easily stick, or we might have the lay Press force Saucer back on us when we first succeed in leaving the Earth at will. Remember "Sound Barrier"!

Benton, Newcastle upon Tyne. R. A. MILNE.

Royal Metropolitan

REFERRING to your leader editorial published in the March 21 issue ("When Timetables Leave No Time"), I am somewhat surprised to observe that you made no reference to the fact that H.M. The Queen Mother on her recent World tour flew in one of the R.A.A.F.'s Convair 440 Metropolitans on all her Australian journeys, except the Adelaide-Perth sector. Despite the lavish publicity afforded to B.O.A.C.'s DC-7C and the Royal Britannias, also the misfortunes of the Qantas Super Constellation, it seems there has been a more or less complete "black-out" on the R.A.A.F.'s V.I.P. Flight contribution to the otherwise highly successful Royal Tour of the Queen Mother.

With one notable exception, U.K. aviation magazines seem to have ignored the "Royal Metropolitan": likewise have all B.B.C. news bulletins relating to the Royal Tour! Had the writer not tuned-in to listen to Radio-Australia's short wave broadcasts, he would have had no reason for sending this letter to THE AEROPLANE!

Nairobi, Kenya. DENNIS M. POWELL.

[Mr. Powell is, of course, quite right to draw attention to the R.A.A.F.'s contribution to the success of H.M. The Queen Mother's recent World tour. As he points out a Convair 440 Metropolitan of the R.A.A.F. V.I.P. Flight was used to fly Her Majesty on most of her Australian journeys.—ED.]

Wanted—An Instructor

I HAVE been a regular reader of THE AEROPLANE for some time now, and have a high opinion of it and find it most informative; though, as a student, I would like to see more often articles on manufacturing processes and more articles on initial design problems from the designer's point of view.

But the real reason for this letter is this. We have a Tiger Moth, maintained, overhauled and hangared at Redhill aerodrome, all for free. All we are asked to do is use it; sounds like a dream and it is, if one is willing to pay for the petrol and can fly. This last requirement is—you will excuse the expression—the fly in the ointment! We have ex-R.A.F. friends who can fly and take us up, but they are not allowed to teach us. So this is our dilemma.

We require, very badly, a person who is qualified to instruct, in return for which we shall either arrange for some free hours or some nominal fee. Surely there must be some person interested enough in the flying movement to help us, even though it does not mean bags of money, for we are only poor students, but eager to learn to fly.

Here's hoping you will be able to publish our plea to help us find a solution.

London, N.W.5. GIOVANNI MUTEVELLIAN.

Perchance

ONE Sunday afternoon in April, 1948, at Burnaston Aerodrome, my flying career nearly came to a dramatic end when a charming young lady in a glider tried to climb above my Auster whilst I was giving her a tow. A rapid release of the tow rope on my part followed by a spectacular landing down wind to avoid some trees saved the situation.

Last Sunday whilst teaching aerobatics in a Tiger Moth I was surprised to see a beautiful red sailplane approach me literally from out of the blue. It was making a steady 45 m.p.h. and I had no difficulty in formating on it for several minutes and exchanging frantic waves with the "fanless wonder" in the driving seat. He was obviously running out of thermals and I watched from above whilst he made a graceful landing at Cardiff Airport. Over a cup of tea in the club house shortly afterwards the glider pilot told me he had come from the Midlands. Naturally, on hearing this I told him about my experience of years ago with the charming young lady from his club. He then told me my name and said that he had been sitting next to me in the Auster during the incident.

The point is that since 1948 various business appointments have caused me to move house to three widely separated localities.

How strange that a sailplane carried on a thermal of chance should have brought us to the same piece of air over Cardiff exactly 10 years to the day and almost to the very hour of our last somewhat colourful meeting.

Cardiff. A. E. BRAMSON.

Aroundabout

The Faithful. Air Cdre. Arthur Clouston, Boscombe Down Commandant, likes to josh the scientists with a story about his test-flying days when, instructed to fly beyond the limits which he knew an aeroplane to be capable of, he could not prevent it crashing, albeit not too badly. Looking round, he saw his scientist passenger, blood running over his bent spectacles, look up from a sum he'd just worked out in his notebook. "I knew it!" cried the scientist, "we have *not* crashed!"

*

Bull. A North Country paper displayed an eye-catching sense of humour when it headed an item "R.A.F. shoot down Vulcan." The facts showed that, missiles or not, the Service still wields a crafty old-fashioned pistol. R.A.F. Waddington beat the hitherto undefeated Vulcan Pistol Team by 669 to 655.

*

"You'd think the Air Council would be the last to let the Industry be so reduced—after all, what will they have to retire to?"

*

Old Croydon pilot, crying into his beer: "We instituted the first blind flying, y'know—up the Caterham railway tunnel."

*

Cut Here and Keep for Reference

News from the London Airport branch of the Wrenterprise: If you should have to wait for a delayed take-off, don't be fobbed off by airline staff's vague promises of "short delay." Watch who tells you. The rank is a guide to delay time:

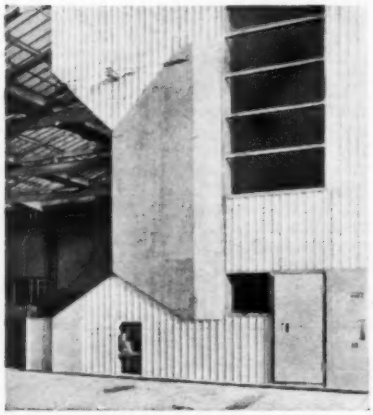
Duty Traffic Officer: 30-min. delay.
Station Manager: 1 hour.
Area Manager: 3 hours.
Chief Executive: Overnight.
Chairman: Not a chance, ask for money back.

*

"—and I'd say 'Now, look 'ere Sandys . . .'"

by Wren

NOTES AND EVENTS



NEAT WORK.—Noral Mansard sheet, supplied by the Northern Aluminium Co., Ltd., is used for cladding the 48 doors of a new wing hangar at London Airport. A recent development to Britain, this type of hangar encloses only the forward portion of each aircraft, leaving the whole of the tail unit protruding. Twenty of the doors are motorized and 12 have a tail aperture.

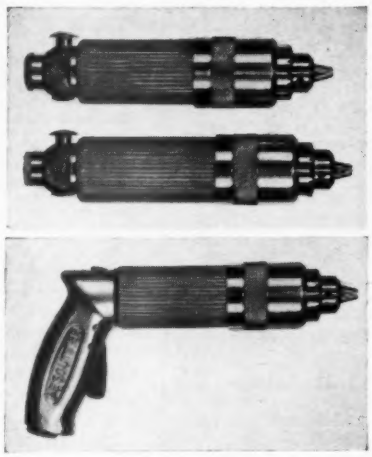
SHELL AIRCRAFT. — The Shell Petroleum Co., Ltd., has formed a new company, known as Shell Aircraft, Ltd., to deal with all matters concerning the operation of aircraft by the Royal Dutch Shell Group of companies, which was formerly conducted by its Aircraft Operations Department. The address of the new company is St. Helen's Court, Great St. Helen's, London, E.C.3; telephone, Avenue 4321.

RADAR ORDER.—Cossor Radar and Electronics, Ltd., has received an order from the Federal German Ministry of Defence for a complete mobile C.R.21 radar installation. This follows a recent demonstration of the equipment in Bonn and makes Germany the sixth country to order the C.R.21.

BRISTOL MAINTENANCE. — Lyte Ladders, Ltd., of Newport, Mon, has produced this aluminium-alloy maintenance platform to the requirements of the Bristol Aeroplane Co., Ltd. It is used in the construction and maintenance of the Sycamore and Type 192 helicopters.

TRAINING SCHEME. — Associated Electrical Industries, Ltd., has organized a training scheme for officers leaving the Services as a result of recent defence cuts. Prepared in conjunction with the Officers' Association, London, it will provide a two-year course for between 110 and 180 officers over the next 4-5 years. The scheme has been designed primarily to equip officers with no technical qualifications for employment in industry.

EAR DEFENDER.—The industrial division of Amplivox, Ltd., London, has developed an "ear-defender" aircrew headset in conjunction with R.A.E., Farnborough. Fully tropicalized and fitted with a liquid-filled acoustic seal, the headsets are to become the standard unit for Transport Command and will be introduced into service when the R.A.F. receives its Britannias.



LITTLE HORSES.—Among the exhibits at the Production Exhibition and Gauge and Tool Exhibition to open at Olympia, London, on May 14 are these Desoutter products. Top to bottom, the Mighty Atom MA.1 $\frac{1}{16}$-in. 2,500-r.p.m. and the Power Atom $\frac{1}{4}$-in. 2,500-r.p.m. pneumatic drills, and the Mighty Atom with pistol grip.

THORN AT BRUSSELS.—Among the many items produced by Thorn Electrical Industries on show at the Brussels Exhibition is the Calvert lighting system consisting of part of the cockpit of a Comet 4. Three main panels and two small side panels are lit by "Plasteck" transilluminated panel lighting using 80 midget lamps. The panel is also used in exhibits developed by the R.A.E. dealing with the structural testing of aircraft and heat barrier research.

New Patents

APPLICATIONS ACCEPTED

796,260.—Bendix Aviation Corporation.—"Altitude indicating instrument."—Sept. 24, 1956 (Sept. 27, 1955).

796,264.—Orgill, R. H.—"Device for indicating the condition or failure of components in an aircraft."—Oct. 9, 1956 (Oct. 20, 1955).

796,400.—Rolls-Royce, Ltd.—"Air intakes for aircraft power plant installations."—Sept. 16, 1953 (Sept. 23, 1952).

796,267.—Blackburn and General Aircraft, Ltd., Laight, B. P., Hand, P. G. E., and Barker, T.—"Aircraft undercarriages."—Oct. 23, 1956.

Applications open to public inspection on June 11, 1958; opposition period expires on Sept. 11, 1958.

Aviation Calendar

May 4.—Tiger Club Aerobatic Competition, at **Sywell Aerodrome,** Northampton.

May 6.—R.Ae.S. Luton Branch lecture, "Analogue and Digital Computers," by Elliott Bros., in the Napier senior staff canteen, **Luton Airport,** at 18.15 hrs.

May 6.—Aviation Forum A.G.M. at the Imperial Hotel, Elizabeth Street, **London,** S.W.1, at 19.00 hrs.

May 7.—Kronfeld Club, talk, "Gliding in New Zealand," by Keith Wakeman, and film on agricultural aviation, at 74 Eccleston Square, **London,** S.W.1, at 20.00 hrs.

May 9.—Helic. Assn. of G.B. lecture, "Canadian Research in the Field of Helicopter Icing," by J. R. Stallabrass, B.Sc.(Eng.), Grad.I.E.E., M.C.A.I. (National Research Council, Ottawa), in the R.Ae.S. Library, 4 Hamilton Place, **London,** W.1, at 18.00 hrs.

May 9-11. — International Air Rally organized by the Channel Islands Aero Club, at **Jersey Airport,** St. Peter.

May 10.—Surrey Flying Club anniversary, and Redhill reunion party, at **Croydon,** at 20.00 hrs.

May 10-11. — International Parachuting Competition organized by the French National Federation of Parachutists, at **Paris.**

May 14.—Kronfeld Club talk, "1958 World Gliding Championships," by Ann Welch, and film on Poland, at 74 Eccleston Square, **London,** S.W.1, at 20.00 hrs.

May 15.—R.Ae.S. 46th Wilbur Wright Memorial Lecture, "Automatic Flight—The British Story," by G. W. H. Gardner, C.B.E., F.R.Ae.S., at the Inst. of Mechanical Engineers, Birdcage Walk, **London,** S.W.1, at 18.00 hrs.

May 16. — Inst. of Navigation lecture, "The Principles of Inertia Navigation Systems," by E. W. Anderson, O.B.E., D.F.C., A.F.C., at the R.G.S., 1 Kensington Gore, **London,** S.W.7, at 17.15 hrs.

May 17-19. — Fourth International Air Touring *rassemblement* at **Quiberon-Le-Roche,** France.

May 18.—Air Rally organized by the Perugia Aero Club, **Italy.**

May 21.—Kronfeld Club debate, "The Golden Age of Gliding has now Passed," at 74 Eccleston Square, **London,** S.W.1, at 20.00 hrs.

May 24.—Cheltenham Aero Club Tea Patrol at **Staverton,** Glos. (15.30-16.00 hrs.)

May 24-26.—R.Ae.C. of Belgium *bienvenue aérienne* at **Brussels.**

May 25-June 1.—Second International d'Angers gliding competition organized by l'Aéro Club de l'Ouest, **France.**

May 26.—Race Meeting organized by the Tiger Club at **Sandown Airport,** Isle of Wight, for the Basil Monk Trophy.

OPEN DAYS.—The National Physical Laboratory, Teddington, is holding its annual open days this year on Wednesday and Thursday, May 14 and 15, when the Laboratory will be on show to over 4,000 guests from the industry, universities and Government departments. There will be about 200 exhibits of N.P.L. work, including many items for the first time.

Personal Notices

BIRTHS

Adams.—On April 14, at R.A.F. Hospital, Nocton Hall, Lincs, to Sheila (*née* Brotherton), wife of Flt. Lt. D. B. Adams—a daughter.

Bolam—On April 13, at R.A.F. Hospital, Ely, to Beryl (*née* Daffern), wife of Flt. Lt. G. D. Bolam—a son.

Curry.—On April 17, at Craigtoun Hospital, St. Andrews, to Janice (*née* Parr), wife of Flt. Lt. A. Curry—a son.

Earland.—On April 17, at The Warren, Abingdon, to Daphne (*née* Halse), wife of Flt. Lt. J. M. Earland—a daughter.

Ford.—On April 17, at R. V. Hospital, Bournemouth, to Joan (*née* Ford), wife of Sqn. Ldr. J. C. Ford—a daughter.

Ford.—On April 21, at Slinfold, Sussex, to Pamela (*née* Clayton), wife of Gp. Capt. W. R. Ford—a son.

Robins.—On April 18, at R.A.F. Compton Bassett, Calne, to Joan (*née* Bennett), wife of Sqn. Ldr. V. A. Robins, D.F.C.—a son.

Thompson.—On April 1, at B.M.H., Nicosia, to Betty (*née* Tupman), wife of Wg. Cdr. J. E. P. Thompson—a daughter.

Upton.—On April 15, at Heacham, Norfolk, to Penelope (*née* Child), wife of Flt. Lt. G. T. Upton—a son.

Wood.—On April 14, at R.A.F. Horsham St. Faith, Norwich, to Gwen (*née* Bristow), wife of Flt. Lt. D. Wood—a son.